JPRS 79229

16 October 1981

West Europe Report

SCIENCE AND TECHNOLOGY

No. 79

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BIOTECHNOLOGY

BACTERIUM PRODUCES PROTEIN FROM METHANE

Duesseldorf VDI-NACHRICHTEN in German 7 Sep 81 p 7

[Text] Annually 50,000 to 100,000 tons of natural gas are still flared in the Persian Gulf alone. In the eyes of Dr. Monir Naguib that is an enormous waste of energy reserves. Instead of simply burning off the natural gas as a waste product of petroleum production, it could be used to produce protein. The basis for this is the capability of certain bacteria to convert the methane of natural gas into protein. Dr. Naguib and his colleagues at the Max Planck Institute of Limnology in Ploen have developed a process with which the protein known as single-cell protein (SCP) can be produced from natural gas in commercial quantities by bacteria.

Methane (CH_4) is the simplest hydrocarbon compound. It is the main constituent of natural gas, making up 80 to 90 percent by volume. In nature it results from fermentation processes, in ocean sediments for example. In their studies of ocean ecologies, the limnologists (inland water researchers) at Ploen have hit upon bacteria which feed on methane. They are thus called methanotrophic bacteria. They use the gas as energy and a source of carbon and build bacteria protein in the process. In this manner they influence not only the carbon and oxygen cycles in bodies of water but also represent a potential source of protein.

However, not all methanotrophic bacteria can be considered for the biotechnological production of protein from methane. Only those types are suitable which have specialized exclusively on methane and which cannot thrive on other carbon compounds such as carbohydrates. In addition they should have the greatest possible substrate conversion; that is, they should assimilate a large part of the methane carbon into their cells so protein production is correspondingly high. Naguib's studies have shown that several phyla, for instance phylum "M102," possess the required characteristics.

However, there were initial difficulties in attempting to develop an industrial biotechnology. The mass cultivation of methanotrophs required could not be induced; and the explosive nature of methane gas presented a technical risk. Dr. Naguib discovered the cause for the growth retardation: while growing, the bacteria excrete materials which strongly retards their further growth. He attached a dialysis system to the culture container which serves as an artificial kidney. Thus all retarding metabolic products can now be removed. This resulted in a 50-fold increase in production from 1 g to 50 g dry weight per liter of bacteria culture. The second obstacle, the danger of explosion, can now be eliminated in modern bioreactors using a type of "air lift" which removes the flash mechanisms from the gas mixture.

The freeze-dried product is powdery and has no odor or taste. In dry form it contains 70 to 80 percent protein by weight. The quality of this bacteria protein is very high. It contains all of the health-essential amino acids. Thus the bacteria protein fulfills the requirements established by the World Food Organization FAO for biologically produced protein. That is, it may be used for food and feed.

Economically, the methane/SCP process would be especially advantageous if it were used locally where large quantities of natural gas are already being released.

9160
CSO: 3102/413

ORGANIC LAYERS USED TO INSULATE SEMICONDUCTORS

Duesseldorf VDI NACHRICHTEN in German 7 Aug 81 p 4

[Text] Of course silicon is indespensable to semiconductor technology; however, there are areas of application in which it falls short. In the field of electronic sensors, in particular, other semiconductor materials have better properties; but applying an insulating coating to the surface of these crystals is a significant problem. Research has been underway for some time at the University of Durham in Great Britain on a coating process which employs the Langumuir basin. This work was reported at a recent meeting in Erlangen.

For a long time it has been known that many organic substances, primarily fatty acids and their salts, can float on pure water as a monomolecular film. This mechanism is operating when an oil spill spreads over the ocean's surface. The fatty acids were singled out for intensive study since their large molecules possess a hydrophylic and a hydrophobic end which cause the molecules to automatically orient themselves on the surface of the water.

If a semiconductor crystal is dipped into such a bath and pulled out, the film is lifted from the water and adheres to the surface of the crystal. By repeated dipping, additional layers can be added one at a time, provided that the surface tension of the film on the water can be held constant. With this Langumuir-basin method, a specified number of these monomolecular films can be transferred to a substrate. At the University of Durham, experiments are being conducted with various organic substances and various semiconductor crystals.

In the case of silicon the application of such insulating films is not necessary since the crystal surface automatically oxidizes to silicon dioxide. The insulating film required for the build-up of integrated circuits is thus inherently present. In the case of other semiconductor materials, such as indium phosphide, gallium arsenide, and cadmium telluride, such films do not develop automatically. Until now only a few laboratories have been successful in coating such semiconductors with insulating surfaces composed of inorganic substances.

In Durham the working group associated with Professor G. G. Roberts has been able to produce such clean boundary surfaces between a diacetylene-polymer film and an indium phosphide semiconductor that the material is suitable for the fabrication of field effect transistors. Equally satisfying results were achieved with 31 layers of a fatty acid salt on a crystal of cadmium telluride.

The effectivity of solar cells has been increased by up to 50 percent by applying 2 unimolecular films of C4-anthracene to a cadmium telluride semiconductor. Together the layers had a thickness of only 2.5mm. Intensive research is presently being conducted at Durham on the application of organic substances to cadmium-mercury telluride, the most important alloy for infrared detectors.

It appears that semiconductors coated with organic films are destined for use in areas other than just the field of radiation sensors (IR detectors and photovoltaic cells). Investigations at Durham showed that there were measurable changes in the spectrum of surface states of a semiconductor coated with a Langumuir film when it was placed in an atmosphere of ammonia, carbon monoxide or hydrogen. The electrical properties were altered by the chemical reaction between the film and the gas. Roberts concludes from this that future gas detectors can be produced with the Langmuir method.

The development of optical wave guides is a special target. The thickness and thus the refractive properties of the organic substances can be selected very accurately. Also, measurements have shown that low damping losses--down to 5 dB/cm--can be achieved in such films.

Organic materials as insulating films for semiconductors have not yet been applied on a technical scale mainly because much experimentation remains to be done on various organic substances whose electrical properties are not yet sufficiently known. Symposium attendees did not rule out the possibility that the Langmuir method can be developed into a commercial process, especially in view of the fact that the application of such surface films is simple and inexpensive.

9160
CSO: 3102/426

ELECTRONICS

NEW VAPOR-DEPOSITION DEVICE FOR SEMICONDUCTOR MANUFACTURE

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 7 Sep 81 p 7

[Article: "Improved Sputtering Method"]

[Text] Balzers AG, Balzers (Liechtenstein). In order to overcome the natural limits of vapor-deposition processes especially in the area of semi-conductor technology, Balzers AG, a subsidiary of the Swiss concern Oerlikon-Buehrle, developed a new type of sputtering facility which they call the "Planar-Magnetron Thin-Film-Process System with Loading Lock." This system lends itself to the production of semiconductor components, opto-electronic components, hybrid circuits and chrome masks. It consists of a high-vacuum chamber with vaporization sources, a loading valve, loading chamber, pump system and control unit. By late fall 20 systems of this type will be in operation in Western Europe according to company information.

Up to five vaporizing sources can be attached to the high-vacuum chamber at the same time; these are also kept under vacuum. Several target combinations can be worked together with different processes; however, the up-time of the chamber is better for like targets. The capability to conduct residual-gas analysis (the substrates are already degased in the feed lock) ensures continuous monitoring of desired film properties such as hardness and resistance. According to the company, up to 60 100 mm-diameter substrates on a 600 mm-diameter substrate tray can be simultaneously coated in less than 30 minutes; however, the time depends on the particular batch process.

The pump system is equipped with a refrigerator-cryogenic pump. Pumping periods are short, amounting to about 8 minutes for a desired vacuum of 2×10^{-6} millibar. The total facility is computer controlled and equipped for single-button operation. The parameters are input via magnetic-tape cassettes. Control accuracy for current and power is closer than plus or minus 1 percent. The entire system is so designed that it can be installed and operated in a clean room with modification.

9160
CSO: 3102/413

ACTIVITIES OF UK IN FLUIDIZED-BED COMBUSTION RESEARCH

British Know-How Discussed

Graefelfing ENERGIE in German Jun 81 pp 223-225

> [Text] The output range of the approximately 20 boilers, which are being operated in England as fluidized-bed-furnace experimental and demonstration system, extends from 0.35 to 30 Mw. This involves new units and remodeled units--in other words, there was hardly a boiler type which the English have not yet tried out. Licensees in the United States are selling fluidized-bed-furnace boilers like "hot-cakes" now. From the other side of the Channel, we are told "that there are no" problems with the furnace.

"You really ought not to be astonished over the fact that I do know something about fluidized-bed furnaces." This sentence may be typical English understatement because it comes from David Gray, the managing director of Coal Processing Consultants, Ltd., a joint enterprise involving the National Coal Board (NCB), Babcock International Ltd., and British Petroleum Company Ltd. (BP).

Gray was one of the conversation partners of the ENERGIE editors who took a closer look on the spot at the fluidized-bed-furnace know-how of the English. The other two were Bryan Beacham, manager of the BP Research Center, and Robert C. Payne, chief of the Combustion Division of the Coal Research Estalishment in the NCB.

Although the English are in some areas further along in fluidized-bed furnaces than the boilermakers in the FRG, they are also having difficulties in making headway on the market. "Industry does not want any fluidized-bed furnaces and no coal; it only wants steam," says Gray whose consultants operate worldwide in the fluidized-bed furnace field.

The illustrations show how various enterprises are interconnected, under the direction of the NCB, to make common cause for fluidized-bed furnace operation. The benefits are supposed to go above all to coal with which the NCB wants to replace 50 million t of oil annually. Right now, about 1 million t of coal are annually being burned in England in fluidized-bed furnace systems. Just about 20 boilers (almost all test and demonstration plants) are working in the output range of 0.35-30 Mw; that includes all currently customary conventional boilers which were converted to fluidized-bed combustion.

Boilermakers and groups in the NCB cooperate closely and each of them benefits to some extent due to the exchange of information. BP with Bryan Beacham is above all interested in selling licenses. This came off quite successfully in the case of Jonston Boiler, in the United States, who have already sold 22 fluidized-bed furnace systems.

Gray's CPC has worked on 13 fluidized-bed furnace projects worldwide and is not tied to any English manufacturers. Feasibility studies in the sector of complete coal refining and fluidized-bed furnace engineering is the job of the 30 staff members who want to corner the market with small boilers.

Here is the No 1 fluidized-bed furnace problem for Gray: "There are no boiler engineers with experience in coal."

Whether it is the boiler or the pipes, there is no talk of difficulties with the fluidized-bed furnace as such; there are supposed to be tried and tested materials for heat exchangers and the combustion efficiency in all types tested is supposed to be more than 90 percent and with some skill that can go up to 98 percent.

Fully automatic operation, the charging and discharging of boilers--these are the things the engineers are concentrating on now. And that applies above all to small systems via which the road to big systems makes sense as Gray and Beacham agree.

If existing boilers are to be converted to fluidized-bed furnaces or if they are supposed to be replaced by them, then one must in the truest sense of the word cut one's coat according to the cloth: either according to the boiler height or according to the height of the room. Says Gray: "Height is a big problem and this is why we are experimenting in fluidized-bed combustion with all possible boiler types to gain experience.

Experience with desulfuration by the way can hardly be gathered in England--the law does not require it. Nevertheless Beacham and Payne maintain that there could not be any problems here. They probably know what they are talking about in the light of their license contacts with the United States.

There is much knowledge and experience coming from R. C. Payne's shop. The Coal Research Establishment in Cheltenham is a real treasure trove for people interested in fluidized-bed furnaces.

Starting with an output of 2 Mw, fluidized-bed furnace operation turns out to be worthwhile--Payne believes; work in the shops at the research center is oriented along these lines therefore. The emphasis here is on automatic charging and discharging of conventional small coal-fired boilers likewise.

The people in England are involved in detail work here. The conversation partners sound convincing when they maintain that there are no problems with boilers and their fluidized bed.

UK Enterprises Supplying Fluidized-Bed Furnace Systems

Babcock Contractors Limited, 165 Great Dover Street, London SE1 4YB.

Babcock Power Limited, Shell Boiler Division, 65 Livery Street, Birmingham, West Midlands B3 1HA.

Danks of Netherton Limited, 257 Halesowen Road, Netherton, Dudley, West Midlands, DY2 9PG.

Deborah Fluidised Combustion Limited, 6 Davy Drive, North West Industrial Estate, Peterlee, Co. Durham.

Energy Equipment Company Limited, Energy House, Hockliffe Street, Leighton Buzzard, Bedfordshipe, LU7 8HE.

Forster Wheeler, Power Products Limited, PO Box 160

Great London House, Hampstead Road, London NW1 7)N

Gibson Wells Limited, 2 Town Gate, Calverley, Leeds, West Yorkshire LS28 5NF.

E Green and Son Limited, Calder Vale Road, Wakefield, West Yorkshire, WF1 5PF.

M E Boilers Limited, M E House, Fengate, Peterborough, Cambridgeshire, PE1 5BQ.

NEI (Northern Engineering Industries Limited), St. James Road, Gateshead, Tyne and Wear NE8 3HS.

NEI Thompson Cochran Limited, Carntyne Works, 300 Myreside Street, Glasgow G32 6BS.

Parkinson Cowan GWB Limited, PO Box 4, Burton Works, Dudley, West Midlands DY3 2AD.

Stone-Platt Fluidfire Limited, Unit 11, Washington Street, Netherton, Dudley, West Midlands, DY2 9RE.

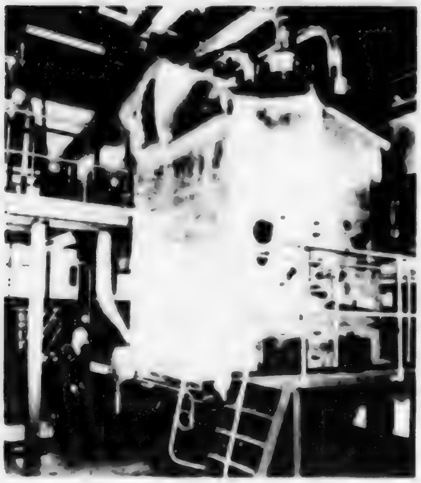
Vosper Thornycroft (UK) Limited, Northarbour Road, Cosham, Portsmouth, Hampshire, PO6 3TR

Furnaces

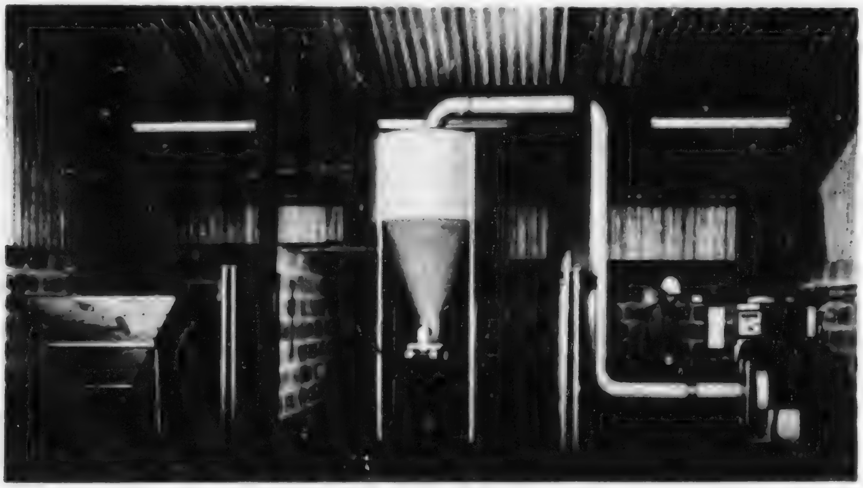
Energy Equipment Company Limited, Energy House, Hockliffe Street, Leighton Buzzard, Bedfordshire LU7 8HE.

G P Worsley & Company Limited, Haydock Lane Works, Haydock, St. Helens, Merseyside WA11 0UU.

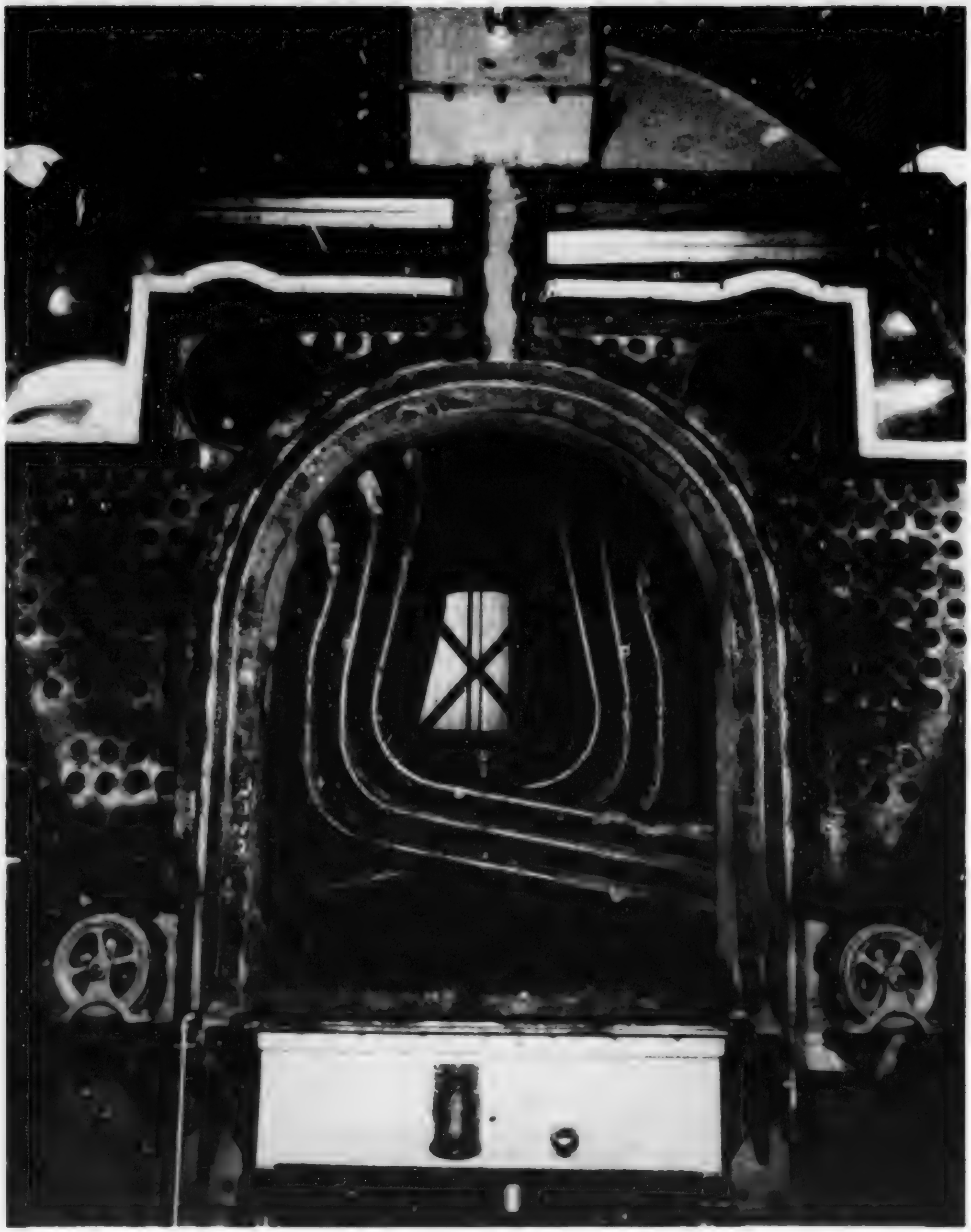
FIGURE CAPTIONS

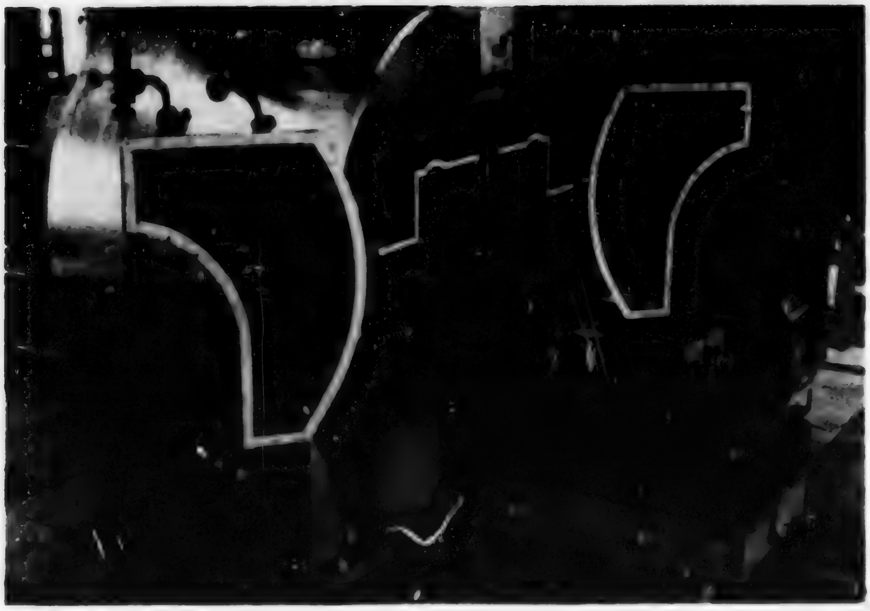


This water-wall-pipe shell boiler was built by Babcock International Ltd. Some wall pipes run through the fluidized bed and work like thermosiphons. The water flows in a natural cycle. At an output of 4.3 Mw, the combustion chamber is 2.7 m high, 1.98 m long, and 1.7 m wide. The prototype is being tested in the Coal Research Establishment.



The National Coal Board developed a pneumatic coal conveyor system based on the suction-nozzle principle. The system comprises a special nozzle unit, corresponding pipes, a cyclone funnel and a suction fan. Via the suction nozzles there is generated the air flow with which the coal is moved to the cyclone funnel where the coal is separated from the air. A corresponding valve at the bottom of the funnel is used for control. The conveyor rates depend on the fan size, on the conveyed air speed, on the system length, and the pipe diameter. A typical short system is 10 m long, has a pipe diameter of 125 mm, and can move 16 t/hr. For classified coal with a magnitude of 12-25 mm, the system is now commercially available; for coal with a size of 0-12 mm, it is now being developed. The test plant is at the Coal Research Establishment in Cheltenham.





In this design by Wallsend Slipway Co. Ltd. (subsidiary of Vosper Thornycroft Ltd.) the point at issue was to increase the capacity of a horizontal-shell boiler. The boiler operates with a low furnace-air surplus; the increased vertical headroom reduces the material carryover from the fluidized bed.

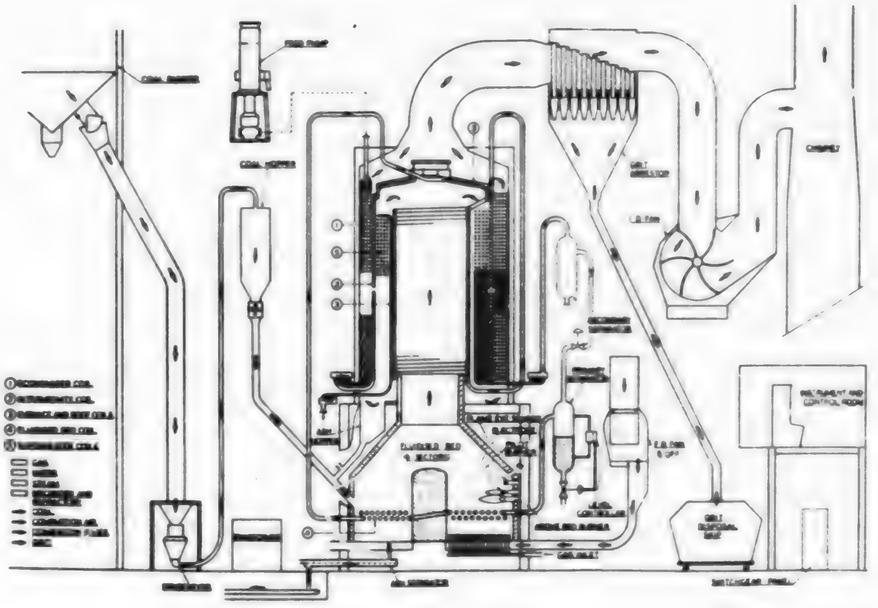
The boiler capacity is 5 MW; the dimensions of the boiler are 4 m high, 3 m in diameter and 3 m long, with a fluidized-bed combustion area of 1.5 m by 2.5 m. In the combustion chamber are 36 "thermosyphon" pipes in which the water circulates in a natural cycle.

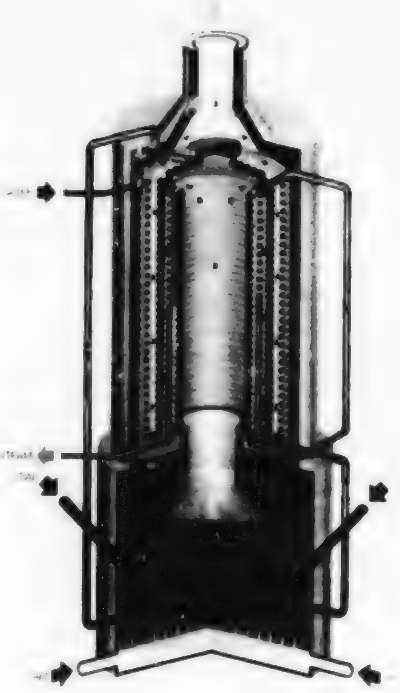
At present, the boiler is being tested at the Coal Research Establishment, Cheltenham.

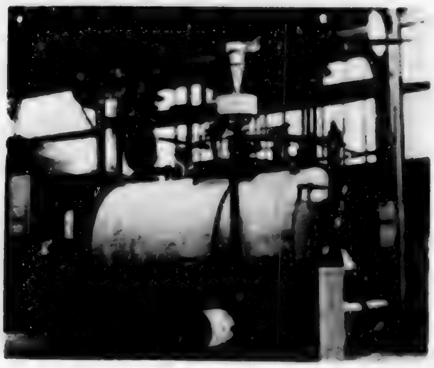
Examples of Combustion Systems

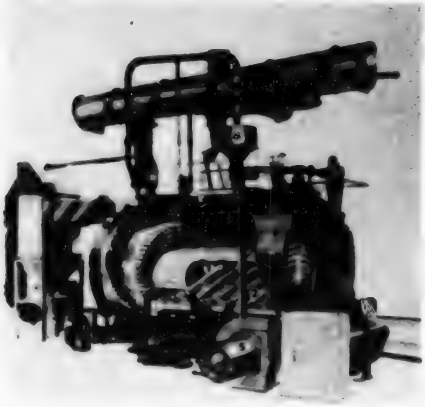
Graefelfing ENERGIE in German Jun 81 pp 225-226

[Text] A 30-Mw fluidized-bed furnace boiler with water pipe coils has now been placed in operation by the British Steel Corporation, Riverdon Works in Sheffield. The plant comes from M. E. Boilers in cooperation with the National Coal Board. The special feature of this plant consists of six separate furnace elements and this is paralleled by the possibility of adjusting the boiler output. In the standard case, two of the segments are always working while the others are in the standby position. If the temperature drops below 650° C during the "break," then the other segments are turned off and the "cooled-off" segments go back into operation. The boiler is about 12 m high and has a bed diameter of 5.3 m. One can use coal with a size of 0-18 mm. The boiler works at 45 bar and 440°C with an output of 36,000 kg/hr.





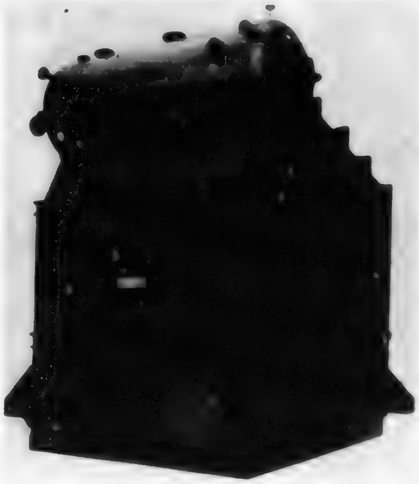


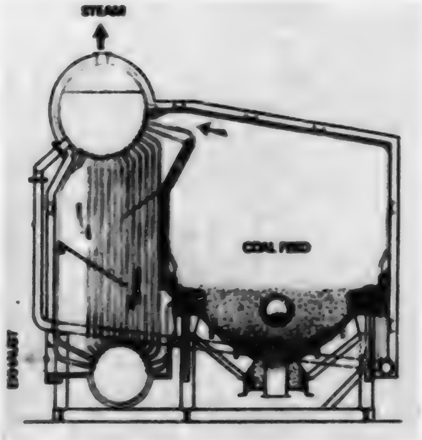


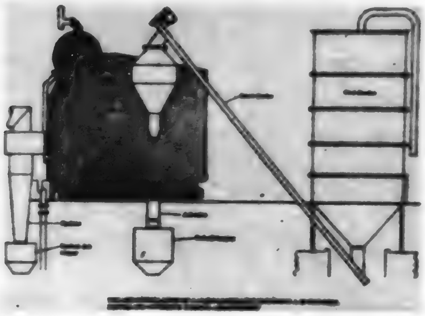
For steam output figures of about 5,000-12,000 kg/hr, Danks of Netherton Ltd. developed fluidized-bed boilers (horizontal shell boilers) which, according to the manufacturer, work at an efficiency of 80 percent. The company offers fluidized-bed-furnace water pipe boilers in the performance range of up to 45,000 kg/hr. The photo shows a horizontal shell boiler for about 8,000 kg/hr of steam.

Compact Boilers

Stone-Platt-Fluidfire Limited believes that it has built and has on order the largest number of fluidized-bed furnace boilers. In point of fact, the enterprise is building or operating 23 commercial installations in the UK and the United States. The output figures are between 1,200 kg/hr and 25,000 kg/hr of steam. The photos show the compact water pipe boiler which is typical of the enterprise and which can be delivered for an output of 1, 3, 5, 7.5, and 10 Mw. Here are the price guidelines: 674,500 Pounds Sterling for 1-Mw boiler, 1,310,000 Pounds Sterling for the 3-Mw unit, 1,615,000 Pounds Sterling for the 5-Mw boiler, and 3,068,000 Pounds Sterling for the 10-Mw unit. The boilers can be equipped for desulfuration. The boiler shown in the photo is 4.25 m wide, 4.25 m high, and 11.5 m long.

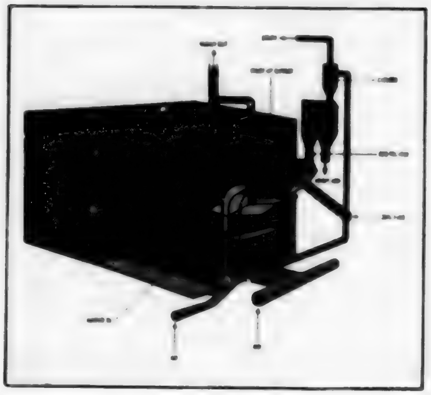






Multifuel

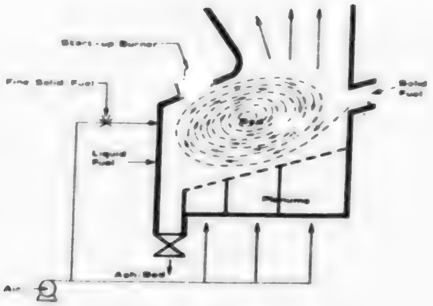
Deborah Fluidised Combustion (DSL) believes that it can convert just about all boilers to fluidized-bed furnace operation--of course they also love to sell new ones. The company has specialized above all in burning the most varied solid-gas and liquid substances and mixtures thereof. For solid fuels, DSL offers fluidized-bed furnace water pipe boilers in the range of 3-15 Mw and with superheated steam the company maintains that pressures of up to 64 bar are possible. An experimental boiler reportedly yielded a combustion efficiency of up to 1.44 Mw/m^3, whereby the boiler efficiency was 80-82 percent.

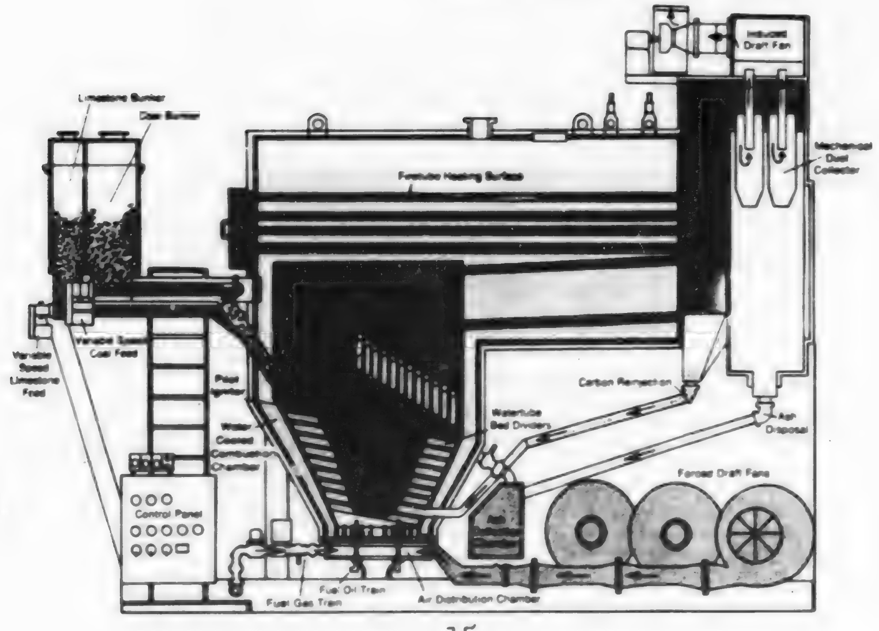


DSL fluidized-bed furnaces are to replace underfeed furnace operation.

Desulfuration

Locomotive boilers by Johnston Boiler Company, United States (license from Combustion System Limited). The boiler links a vertical combustion chamber with horizontal flue-gas pipes. The water is heated partly by the pipes which are dipped into the fluidized bed and partly in pipes which run laterally thereto over the fluidized bed and also by the flue-gas pipes which lie in the water. The fluidized bed, consisting of limestone, sand, and ash, can be taken out of the boiler entirely for maintenance purposes. The boiler is available for commercial employment in sizes of 1-15 Mw output and pressures of up to 20 bar.





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REPORT ON NATIONAL WIND-ENERGY RESEARCH PROGRAM

History, Present Status

Amstelveen ENERGIESPECTRUM in Dutch Jul-Aug 81 pp 172-177

[Article by P.F. Sens]

> [Text] The "Wind Energy in the Netherlands" conference is the first to be devoted to a national research program. For that reason it seems desirable to analyze what a national research program consists of and wherein it differs from other programs. The national character of these programs, of which wind is not the only one, expresses itself in the cooperative association between institutions of higher education (universities and university-level institutes), research institutions (such as the National Air and Space Travel Laboratory, TNO [Netherlands Central Organization for Applied Natural Scientific Research], and ECN [Energy Research Center of the Netherlands]), industry, national institutes such as the KNMI [Royal Dutch Meteorological Institute], and consulting and engineering offices. The carrying out of national programs is thus not assigned to one specific institution, but to a number of parties that are asked to come and sit at the table of the program and contribute their own specific expertise. It is the intention to engage these specific expertises in the program, but not to concentrate them at one place. The desire sometimes expressed to establish a specific institute for wind energy must also be considered in this light. Sweeping these parts of the research together in one place would take them away from the soil in which they are now thriving.

The multidisciplinary character of the program, to which many parties make a contribution, does, of course, call for a definite administrative organization and a central point where the achievements of the program and the results can be worked up and evaluated.

In 1976 the authorities asked ECN whether ECN could in this sense take on the program direction and the program management of national research programs and what organizational measures ECN could take for that purpose. ECN gave a positive response and in 1976 established the Bureau of Energy Research Projects, which is organizationally under the ECN, but works directly under the government and reports to the government. With regard to their content the research programs coordinated by the Bureau of Energy Research Projects do not come within the ECN's field of responsibility, and there is no question of ECN management except for the part played by the ECN in carrying out a program. It is perhaps well to point out emphatically here that the national research programs are neither a program of the Bureau of Energy Research Projects nor a program of the ECN, but a government program. In the case of wind energy the funds are made available by the Ministry of Economic Affairs; the coordination and the management are assigned to the BEOP [Bureau of Energy Research Projects]. The carrying out of a program is monitored by a monitoring commission appointed by the minister, which reports regularly on the progress of the work. As coordinator and manager, BEOP often organizes the creation of program proposals or of proposals for follow-up programs, but these must be accepted by the government and incorporated into the government's energy program in order to be carried out. The BEOP's task in the national programs is independent of whether the ECN is or is not involved in the carrying out of the program. The two functions, management and participation in the execution, are strictly separated.

The fact that BEOP "resides" at ECN has a number of practical advantages with respect to its being able to make use of the infrastructure present at ECN, especially in the field of administration, juridical, and technical assistance in management tasks, and, for example, in organizing a big conference. BEOP cannot undertake all this alone, with a total complement of 10 persons for, at the moment, 5 programs to be managed.

In the course of the conference a number of parts of the National Wind Energy Research Program will be discussed in the various lectures. For that reason, in this bird's-eye view the emphasis will be laid on the subjects that are not a part of any of the later lectures. In addition it should be pointed out that one lecture, Mr Smulders's, is devoted to the other wind energy research program, for the benefit of the developing countries. That program is financed by the Ministry of Foreign Affairs within the framework of technical assistance to countries of the Third World. A good cooperation is maintained with the program and there is a regular exchange of information.

The aim of the National Wind Energy Research Program is to answer the question whether wind energy in the Netherlands can make a significant contribution to the energy supply. This program was formulated in 1975 by a study group from the National Steering Committee on Energy Research. The proposed program was to run for 5 years and began on 1 March 1976. We are thus now at the end of the program. On behalf of the Bureau of Energy Research Projects the present status has been evaluated and set down in a report. This report is the subject of Mr Pelser's lecture.

The evaluation sets forth what has been achieved and where there are still gaps. On the basis of this a follow-up program under the direction of the BEOP has been formulated that is explained in Mr Piepers's lecture.

With respect to the decentralized use of wind energy this follow-up program has been accepted in principle by the minister of economic affairs. Mr Beurskens's lecture is devoted to this subject. The budget available for the program looks as follows:

At the beginning, on the basis of the original proposal, the minister of economic affairs promised a sum of 15 million guilders for a 5-year program. In the fall of 1978 an inflation correction of 3.5 million guilders was added. In the course of the program it was considered desirable to fit out the 25 meter horizontal-axis turbine that was to be built as a measuring installation rather than a prototype operating machine. Chiefly to meet the extra costs for measuring instruments involved in this, a supplementary budget of 700,000 guilders was granted. In addition, a sum of 900,000 guilders was voted by the Ministry of Science Policy for a number of specific projects in the field of decentralized use and the development of tipvanes during the years 1979 and 1980. The total amount thus comes to 20.1 million guilders, not including the ECN's own costs both with respect to participation in the carrying out of the program and with respect to performance of the management tasks. This participation of ECN not appearing in the budget has gradually increased and now amounts to a financial value of about 2.5 million guilders a year. If we had to divide the program of the past 5 years into 3 main subjects, they would be:

- Central application of wind energy,
- Decentralized application of wind energy, and
- Basic research.

In rough outline the distribution of the budget over these three main subjects is:

- Central application: 9.5 million guilders,
- Decentralized applications: 3.7 million guilders, and
- Basic research: 6.9 million guilders.

Table 1. Financial Means of NOW [National Wind Energy Research Program]

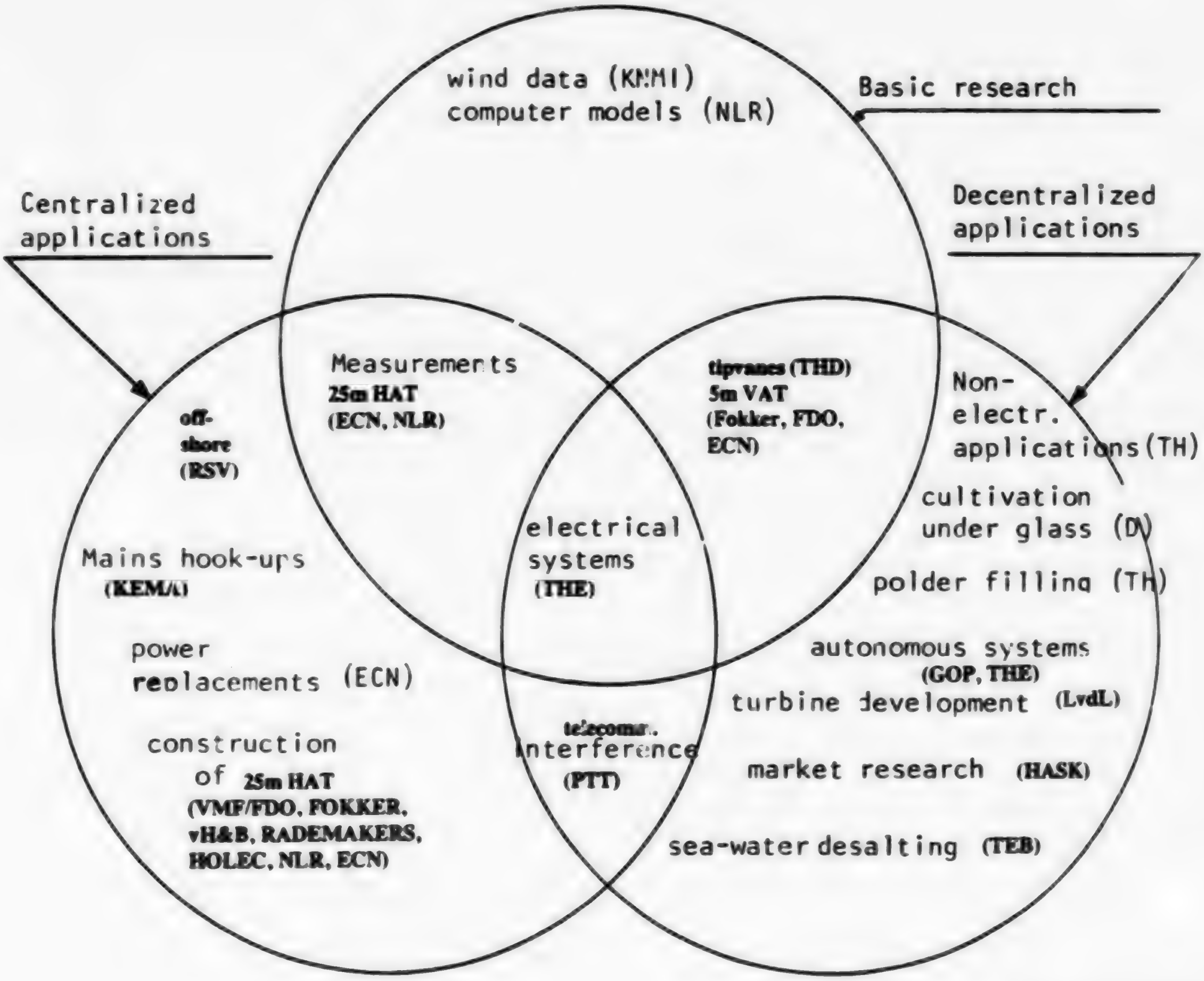
Ministry of Economic Affairs	Guilders
5-year Budget for 1976-1981 (1975 level)	15.0×10^6
Correction for inflation in the fall of 1978	3.5×10^6
Supplementary grant for 25-meter horizontal-axis turbine	0.7×10^6
Ministry of Scientific Policy	
Supplementary grant for tipvane project and decentralized applications	0.9×10^6
Total*	20.1×10^6

*Exclusive of the ECN contribution in manpower, now ca. 2.8×10^6 a year.

Allegations that in the National Wind Energy Research Program only 3 percent of the budget is devoted to small-scale applications must thus be blamed on incomplete information. The basic research is for the benefit of both the central and the decentralized part of the program.

The program has gone through the following phases in time:

Phase 1 from March 1976 to June 1977. In this phase the first studies were started up and an inventory was taken of the available knowledge in the Netherlands and abroad. At the same time the 5-meter vertical-axis turbine was built and set up at the Fokker plant at Schiphol-Oost.



ENERGIESPECTRUM

Figure 1. Principal Subjects of the National Wind Energy Research Program.

Abbreviations:

D	Drayer
ECN	Energy Research Center of the Netherlands
FDO	Physics-Dynamics Research Laboratory
GOP	Goppel Engineering
HASK	Haskoning
HAT	horizontal-axis turbine(s)
KEMA	Office for the Inspection of Electrotechnical Material
KNMI	Royal Dutch Meteorological Institute
LvdL	Lagerwey v. d. Loenhorst
NLR	National Aeronautical and Astronautical Research Institute
PTT	Post, Telephone, & Telegraph
TEB	Tebodin
TH	Technical University
THD	Technical University of Delft
THE	Technical University of Eindhoven
VAT	vertical-axis turbine(s)
vH&B	Van Hattum and Blankevoort
VMF	[expansion unknown]
VMF	/United Machine Works/

Phase 2, from June 1977 to the end of 1978, was chiefly taken up with measurements with the 5-meter vertical-axis turbine and the design of the 25-meter horizontal-axis turbine.

Phase 3, the last 2 years, has seen the construction of the 25-meter horizontal-axis turbine and the starting up of a number of activities concerned with decentralized use of wind energy.

This rough outline does not do justice to the numerous studies and developments in the program, only a part of which, as remarked earlier, will be up for discussion during the conference. For that reason a complete picture of the parties involved in the program is given in Table II, with an indication of the activities carried out by those parties.

The Royal Dutch Meteorological Institute has taken care of making wind data available. This subject will be discussed by Mr Builtjes, whose lecture will also deal with the research done at TNO on suction effects in wind turbine complexes.

The air and space travel department of the Technical University of Delft has been engaged in developments of the tipvane concept. These are small transverse wings set at the end of the rotor blades which have the effect of increasing the mass flow over the rotor surface. Theoretical and experimental findings show that a drastic increase in yield can be attained in this way. At the moment there is a test installation at the Stichting Energie Anders [Alternate Energy Foundation] in Hoek van Holland where the concept will be tested out under real conditions. Thus far measurements have been done chiefly in a wind tunnel.

Rijn-Schelde-Verolme, with Hydronamic as a subcontractor, has been engaged to do a study of possible sites for wind turbines at sea and the costs connected therewith. It appears that three areas in the North Sea may be considered for the purpose, but the most northerly area is so remote that it will certainly not be the first choice. It must be taken into account that energy supplied in this way will certainly be twice as costly as that from wind turbines on land.

The KEMA at Arnhem has been engaged in studies concerning fitting wind energy into the electrical network and the fuel to be saved in that way. This will be discussed in greater detail in Mr Van Nielen's lecture. FDO-Technical Advisers, a VMF working group, has been engaged in an early stage of the program in the instrumentation of the 5-meter vertical-axis turbine, built by Fokker, and in a later phase with the design and consultation concerning the construction of the 25-meter horizontal-axis turbine. This is sure to be discussed in Mr Reijnders's lecture.

This 25-meter installation includes a number of components that are the result of research and development work entrusted to various concerns in the early stage of our program. This is especially true of Fokker, which after construction of the 5-meter vertical-axis turbine began research on production methods for manufacture of the rotor blades of the 25-meter HAT. The final result of this was that the rotor blades were indeed manufactured by Fokker.

The National Aeronautical and Astronautical Laboratory [NLR] made a contribution to the development of computer models for rotor systems; the NLR has also been closely connected with the setting up of measurement programs and the selection of measuring apparatus for both the 5-meter vertical-axis turbine and the 25-meter HAT.

The conversion of mechanical energy into electrical energy in a usable form has been the subject of research and development both at the Technical University of

Eindhoven and at HOLEC [electrical equipment firm]. The electric apparatus in the 25-meter HAT was determined upon in repeated consultations between these two parties and the ECN, and was ultimately manufactured and supplied by HOLEC. The gearbox of the wind turbine is the result of research and development work at Rademakers Aandrijvingen [Rademaker's Drive Systems] in Rotterdam.

Table II. Participants in NOW [National Wind Energy Research Program] *

KNMI	- wind data over land and sea - vertical velocity profiles - turbulence - predictability
TNO	- suction effects in turbine installations
TH Delft	- "tipvane" development
RSV [Rijn-Schelde-Verolme]	- installation of wind turbines at sea
KEMA	- integration of wind turbines into the electrical net
FDO	- instrumentation of the 5-meter HAT - design and construction consultation on the 25-m HAT
Fokker	- design, construction, and operation of the 5-m VAT - development and manufacture of rotor blades for the 25-meter HAT
NLR	- computer models for rotor systems - measurements at trial installations - instrumentation and measurement program for the 25-m HAT
TH Eindhoven	- electrical systems for converting mechanical energy into electrical energy
HOLEC	- evaluation of electrical systems - construction of the electrical system of the 25-m HAT
Rademakers	- regulable planetary gear transmissions - development and manufacture of the planetary gearbox for the 25-meter HAT
Van Hattum & Blankevoort	- design and construction of the foot of the tower of the 25-meter HAT
ECN	- working up the measurement data from the 5-m VAT - operation and measurement program of the 25-m HAT - potential and costs of wind energy - power replacements - evaluation

*Other abbreviations are explained as far as possible on first occurrence; see especially the expansions below Figure 1.--Translator

As the last party that has been involved in the construction of the 25-meter HAT we may mention Van Hattum and Blankevoort, who undertook the civil engineering work.

Table III. Participants in the Work on Decentralized Applications

Drayer	- use in cultivation under glass
Theyse	- non-electrical applications
	- polder draining
Haskoning	- initial exploration of export possibilities
Tebodin	- use in desalting sea water
Dynaf	- agricultural use (cold storage)
Lagerwey v.d. Loenhorst	- turbines for decentralized applications
Goppel Engineering	- wind turbine-diesel motor combination
PTT	- interference in telecommunications

ECN's involvement has increased gradually in the course of the program. At the beginning ECN was not involved in the execution at all. When a measurement program was carried out in connection with the 5-meter vertical-axis turbine, it was found that ECN had the apparatus and the techniques "in house" for processing great quantities of measurement results. The statistical techniques had been developed within the framewoerk of measurements of neutron noise in nuclear reactors. ECN thereupon became a partner in the program surrounding the 5-meter HAT. Later ECN's involvement has steadily expanded, especially as Petten was chosen as the site of the 25-meter HAT.

The situation now is that ECN will take care of managing the operation of the 25-meter HAT and also carry out the measurement program and analyze the measurement results. In addition, a definite project group is being formed at ECN which BEOP can call in in connection with appraisal of the numerous questions that arise in the field of wind energy.

In the field of decentralized application of wind energy a number of activities have been started up, which are shown in Table III. The Drijer* Engineering Office has made a study of the possibilities of application of wind energy in cultivation under glass, the idea being direct excitation of heat A trial project in this field is in an advanced stage of preparation.

Theijse* Engineering Office made a study of the application of wind turbines for polder draining. A detailed plan is now completed and we hope to begin soon with a first trial windmill.

A first start toward study of export possibilities for our industry in the field of wind turbines has been made by the engineering office of Haskoning at Nijmegen. On behalf of BEOP, Tebodin has done a comparative study of the possibilities of using wind (and also solar energy in this case) in the various water desalting processes.

Dynaf, at Alkmaar, has done a system study and made a sketch for a combination of a wind turbine and a heat pump to generate electricity for a dwelling house and a cold-storage house for agricultural products. The wind turbine necessary for this was established not long ago in the testing field at ECN and will be tested, measured, and appraised for safety there. Goppel Engineering in Rijnsberg, under

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*Spelled Drayer and Theyse respectively on Table III.--Translator

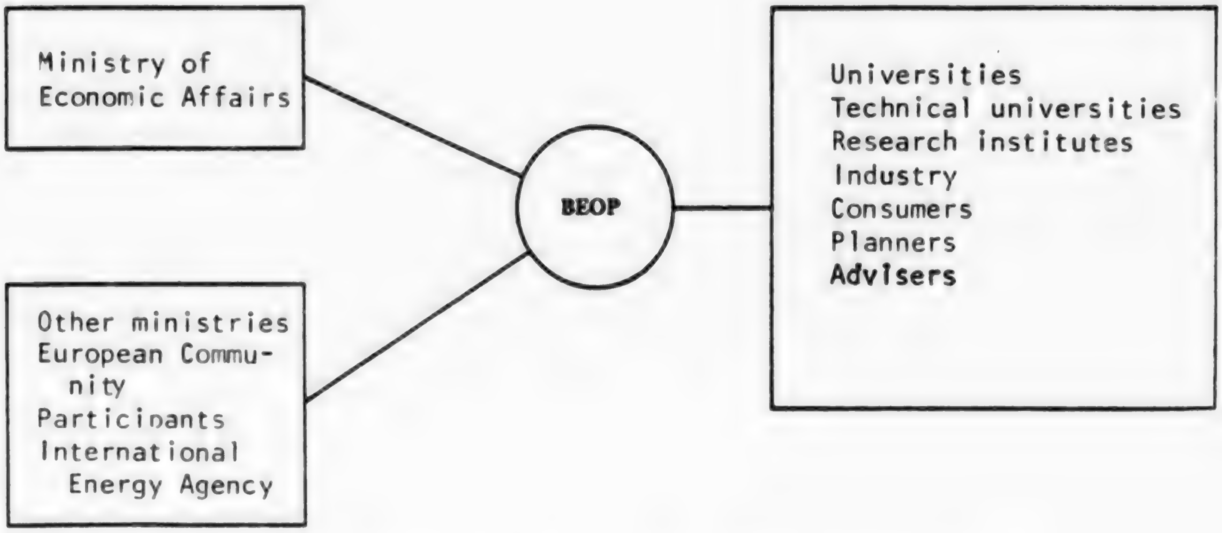


Figure 2. Organization of Wind Energy Research.

contract with the National Research Program, is studying an autonomous system consisting of a combination of a diesel motor and a wind turbine.

The research done by the PTT [Post, Telegraph, and Telephone] on possible interference with telecommunications by wind turbines may be regarded as a common part of the programs.

It should also be mentioned that through the cooperation of the National Planning Service, KEMA, and the Ministry of Economic Affairs, a first study has been done of the planning aspects of the use of wind energy. Mr Van Essen's lecture deals with this. In Figure 2 an attempt is made to group the subjects that have just been run through in such a way that their involvement in the search for central and decentralized applications and in basic research is made clear. A large number of subjects are of significance to one of these categories as well as another. In his lecture Mr Pelser goes into the results attained for a number of matters; we are contenting ourselves here with this factual summing up of the activities.

In conclusion, something about the international cooperation in the field of wind energy. The Netherlands is a participant in the wind energy program of the International Energy Agency in Paris and has in fact played an important initiating part there. In particular, research on the suction effects and on the interference with telecommunications constitute a part of the international cooperation.

In the European Community's program only a very small part of the budget is devoted to wind energy as a part of the solar energy program, but there is a good chance that there will be a change here in the coming years. The Netherlands is actively involved in the discussion of this matter within the EC.

In addition, a bilateral cooperation has recently been established with Indonesia, and recently two Indonesian engineers worked for 5 months in Petten on the 5-meter Darrieus turbine program. This turbine, which has already played out its part in our own program, was moved 6 months ago from Schiphol to Petten, where it was rebuilt and reinstalled. Within the framework of the cooperation with Indonesia, the machine will be turned over to the Indonesian institute for aeronautics and astronautics.

Lastly, two final observations. It can be stated that the scope of the wind energy program has increased over the past 5 years. The program has grown and will continue to grow in the future. The follow-up program that is being formulated by BEOP is of greater scope than the program carried out hitherto. In tha connection BEOP's management functions are also expanding, and it is absolutely necessary for the staffing to be adapted to this growing situation.

A second observation has to do with the rôle of Netherlands industry in the wind energy program. Thus far the industrial part has been nearly 100 percent paid for out of the program, but the time seems to have come when Netherlands industry must participate in and contribute to these developments partly on its own, if it does not want to lag behind foreign industry. It must be conceded that foreign industrial concerns are going to play a more and more active part in the field of wind energy in the Netherlands. This applies both to centralized and more particularly to decentralized applications.

A certain reserve on the part of Netherlands industry is to be explained, of course, by the fact that there is as yet no concrete prospect of a Netherlands market. For that reason it would be greeted with applause if a clearer picture could be obtained of public policy with regard to the use of wind energy in this country. Can we really interpret the 2,000 MW from wind energy mentioned in the government's energy paper for the year 2000 as a concrete market figure, and if so, by what means does the government intend to achieve or even encourage that? It would mean that between now and the year 2000 two wind turbines of about 50 meters in diameter, twice the dimensions of the Petten windmill, would have to be put into service every week. What figures can we assume with regard to the decentralized applications of wind energy? Clarity in this could be an important stimulant to getting industrial activity started in the field of wind energy.

The answer to the question whether wind energy can play a significant part in the Netherlands energy economy is that there are enough positive prospects in sight to encourage the application strongly and to continue the research directed to that end.

Continued Studies Planned

Amstelveen ENERGIESPECTRUM in Dutch Jul-Aug 1981 pp 201-204

[Article by G.G. Piepers]

> [Text] The National Wind Energy Research Program (NOW) formally ended on 1 March 1981. The aim of the program was not primarily to fill up our country with windmills, but to investigate how the wind as a source of energy could make a contribution to the energy supply, with the principal aim of saving fossile fuels.
>
> The results of the 5-year research and development work are set forth in an evaluation report. The final report also includes conclusions and recommendations, the most important of which are:

- Wind energy offers sufficient prospects to provide a powerful stimulus to make use of it;
- Before its large-scale introduction can be justified, however, a large number of bottlenecks need to be eliminated;
- Elimination of the bottlenecks can be effected in part by carrying out a follow-up program.

The favorable prospects have to do both with centralized application--production of electricity by wind power plants--and with decentralized applications. In the latter case the consumer of energy has his own windmill.

Decentralized use can generally be realized in a shorter time than the construction of wind power plants, because:

- The technical problems involved in small to medium-sized windmills can be solved more readily;
- The amounts needed for financing are limited in scope;
- The interest on the part of potential consumers is great; and
- The use of wind power is already beginning to be economically attractive to certain categories of consumers.

The authorities can have a stimulating influence by:

- Granting subsidies and development credits;
- Getting rid of all sorts of interfering restrictions; and
- Issuing unambiguous safety regulations.

The electric companies can make a contribution by allowing large-scale parallel operation with the public network and giving a reasonable compensation for the electricity supplied to the network.

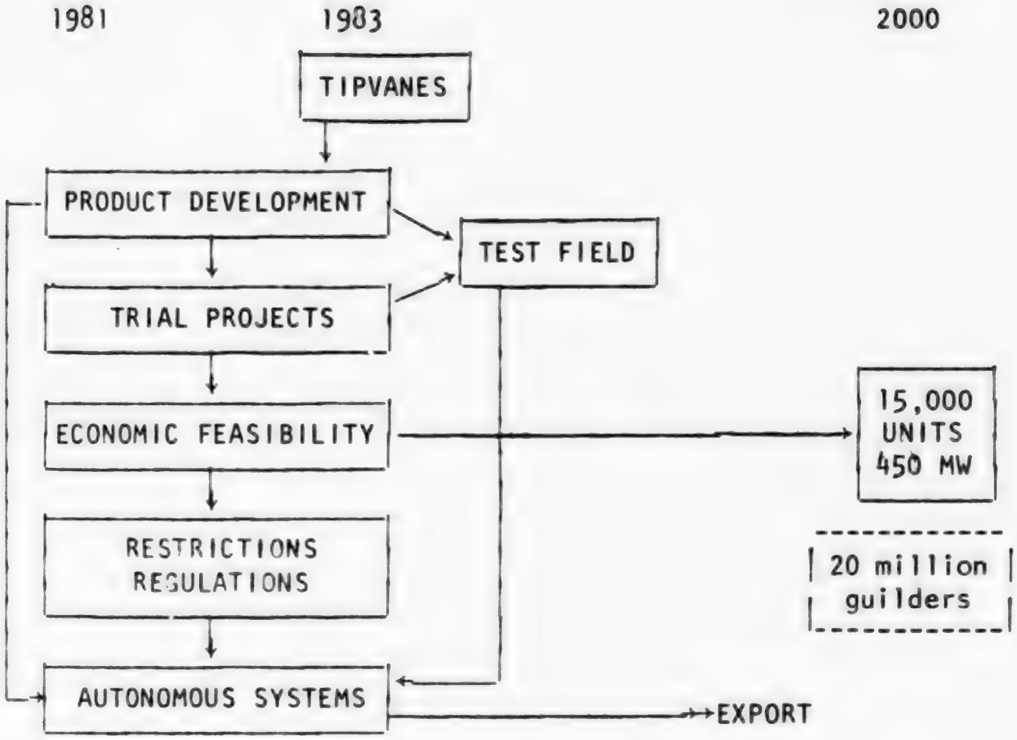
The situation is much more complicated for centralized application. Because of the large investments necessary, the realization of wind power plants is possible only if a number of conditions are met:

1. The use of wind as a source of energy should be a part of an energy policy to be pursued by the public authorities. This implies taking such measures that the 2,000 to 3,000 large windmills in the year 2000 mentioned in the government's energy paper can be realized.

2. A positive attitude of the Cooperative Power Production Plants (SEP) with regard to the incorporation of wind-generated power into the electricity-producing facilities.

3. Willingness of Netherlands industry to set up a production line for the manufacture of large numbers of large windmills.

Now it is self-evident that in the last case the large investments involved are justified only if the government maps out a clear policy line with regard to the use of wind energy.



DECENTRALIZED APPLICATION

The "Wind Energy Systems Act" of 1980 in the United States can serve as a model for this. It establishes by law that in 1988 a wind power of at least 800 MW must be realized, 100 MW of it on a small-scale basis.

Without waiting for the official reactions of the authorites to the recommendations of the final report, the Bureau of Energy Research Projects (BEOP) of ECN [Energy Research Center of the Netherlands] has made a good start on the formulation of a follow-up program. The problem here, however, is that such a program should be attuned to the energy policy to be followed by the authorities. It must be a task-setting program, aimed at the introduction of a definite wind power within a specified period, as is the case, for example, with the American program.

The follow-up program to be presented is made up of three main parts:

- Decentralized application;
- Centralized application; and
- Basic research.

The follow-up program also contains sections dealing with international cooperation, with organization, and with financing.

Each main part embraces a number of related subprojects that have to do with specific aspects of the technical, economic, and planological problems. The aim of the program is set forth as follows:

- Doing research and development work;

- Giving support to firms;
- Advising government agencies, so that after a period of 3 to 5 years wind energy systems can be available with which wind power can be justifiably incorporated into the national energy supply on a large scale, so that in the year 2000 at least 15,000 small windmills (total power 450 MW) and 1,000 large units in wind power plants (total power 2,000 MW) have been installed.

Decentralized Application

Decentralized application embraces the following component projects:

1. Product development; i.e., design and construction of cheap and reliable windmills with capacities of 10 to 100 kW.

2. Feasibility studies; i.e., finding out for what categories of consumers application is attractive or is becoming so.

3. Finding out how obstacles can be eliminated; setting up regulations concerning safety and prevention.

4. Carrying out a number of test projects for specific applications.

5. One important component project is development of autnomous systems; i.e., the windmill-diesel generator combination. The potential applications are enormous; there are good export possibilities here for Netherlands industry.

In connection with the continuity of the activities of the various participating institutes and firms involved in the NOW and the very great interest of potential consumers, as early as November 1980 BEOP presented proposals for a 3-year small-scale program. Agencies have cooperated in the realization of the decentralized program that had already pleaded independently of the NOW for the carrying out of a small-scale wind energy program.

The minister of economic affairs has since approved the program in principle. But the carrying out of the program is subject to the condition that each component project requires separate approval of the minister. In practice this requirement has been found to have a rather restraining effect on BEOP's readiness for action.

Centralized Application

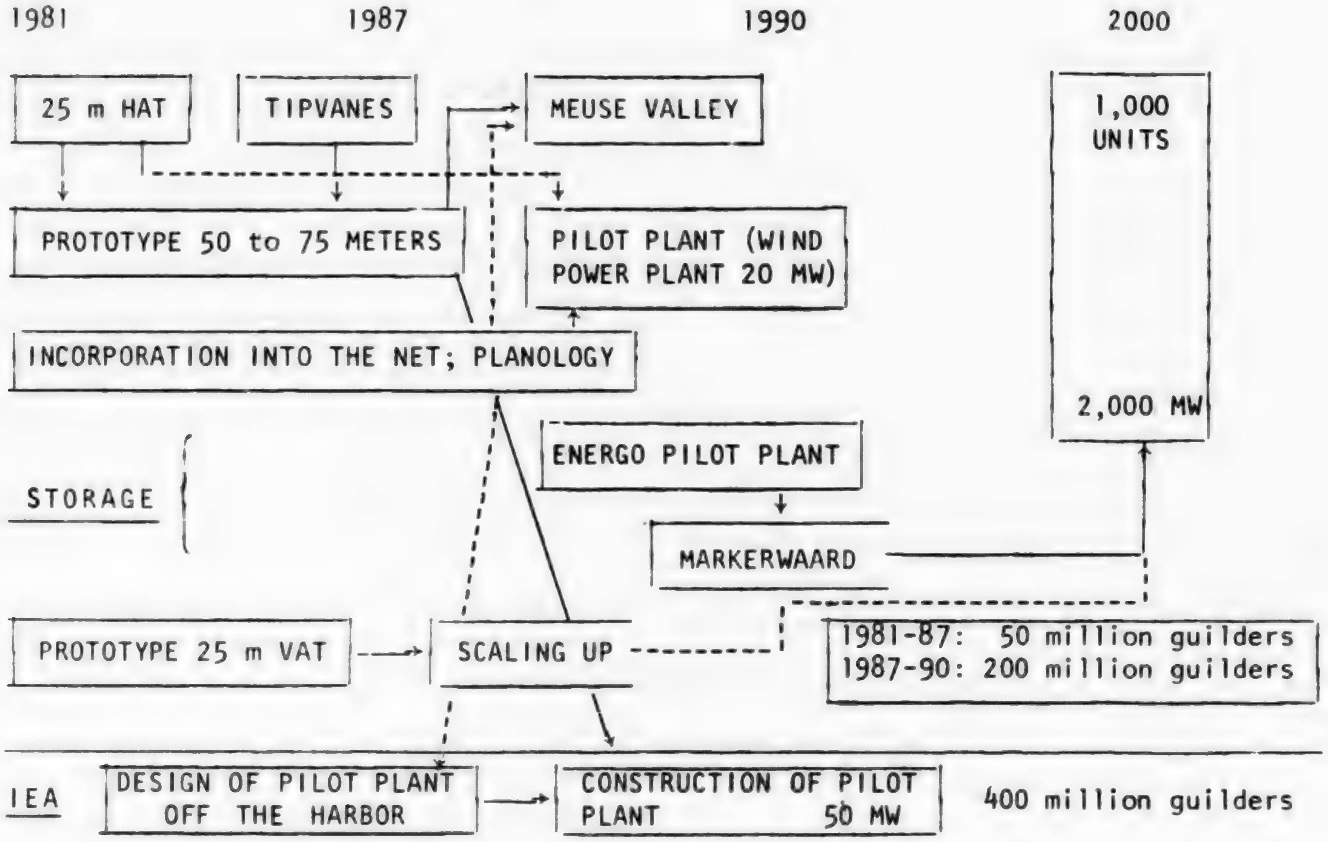
Centralized application involves the construction of wind power plants consisting of large numbers of large windmills. The three most important bottlenecks are:

1. Design and construction of cheap, reliable windmills at an economically justifiable price.

2. Incorporation of wind power plants into the system of conventional electricity-producing units so that a substantial saving in fossile fuels and in conventional capacity is achieved.

3. Making suitable locations available for the required numbers of windmills.

In the Netherlands we hope to master the technical problems by carrying out experiments with the windmills at Petten. The carrying out of a testing program is also


1981
1987
1990
2000
25 m HAT
TIPVANES
MEUSE VALLEY
1,000 UNITS
PROTOTYPE 50 to 75 METERS
PILOT PLANT (WIND POWER PLANT 20 MW)
INCORPORATION INTO THE NET; PLANOLOGY
2,000 MW
ENERGO PILOT PLANT
STORAGE
MARKERWAARD
PROTOTYPE 25 m VAT
SCALING UP
1981-87: 50 million guilders
1987-90: 200 million guilders
IEA
DESIGN OF PILOT PLANT OFF THE HARBOR
CONSTRUCTION OF PILOT PLANT 50 MW
400 million guilders

CENTRALIZED APPLICATION

the first component project in the centralized program. The next component project embraces design, construction, and testing of a prototype windmill with horizontal axis of optimal dimensions for use in wind power plants. Last are the findings with the windmill with vertical axis, since further study is necessary of whether this type is also to be considered for large-scale application.

For that reason the construction and testing of a vertical axis prototype with a diameter of 25 meters has been adopted as a component project. The design has already been completed. For both types it is necessary to find firms that are willing and able to set up a production line on the basis of their own design.

At one time there was an effort to get Netherlands industry involved as much as possible in the construction of the 25-meter HAT. It had only limited success. Furthermore, Fokker is not planning to manufacture rotor blades in the future.

In the program proposals the design, construction, and testing of a "pilot" wind power plant consisting of 10 to 20 units with a total rated capacity of 20 MG is included as a component project. A site somewhere in North Holand is under consideration, not to far from ECN at Petten. The Provincial Electric Plant of North Holand (PEN) has agreed in principle to cooperate.

The incorporation of wind power plants in Netherlands electricity production requires further study. This should not be based entirely on the structure planned by the KEMA [Office for the Inspection of Electrotechnical Material], according to which wind power is regarded as more or less an alien element. Study should also be devoted to what a system of generating plants will look like if consideration is given to as great a wind-generated capacity as possible from the outset.

Although it is really a part of the decentralized application, because of its size a component project for use of wind energy for the benefit of an industrial concentration in the Meuse valley should be included. Ten large windmills or so, located together at a suitable spot in or near the Meuse valley, would supply electricity for a number of large industrial plants that use a great deal of energy. Connection with the electrical network would of course be necessary to take care of periods with little wind. Since the industries in question can absorb all of the energy supplied by the windmills, the quality of the current supplied need not meet the high requirements set by the network.

Within the framework of the National Wind Energy Research Program and also in cooperation with Great Britain, the United States, and Sweden and in relation to the IEA [International Energy Agency], the combination RSV [Rijn-Schelde-Verolme] and Hydronamic has done a study concerning the setting up of windmills at sea. It is the intention that the four countries will present a proposal to the IEA for working out a joint plan for an offshore installation of a specified size, to be situated at one or more locations previously agreed upon. In addition to production of electricity, the possibilities of hydrogen production are also being looked at in this connection.

An important disadvantage connected with the use of wind energy in the society of today is the poor adjustment between the demand for energy and the energy supply. This disadvantage can be overcome to a significant degree by the use of storage systems. The study of storage by means of water power is already a part of the Markerwaard and Energo projects. Not long ago the "Underground Pump Accumulation Center in the Netherlands" (OPAC) proposal, begun by Haskoning, Voker Stevin, and the Technical University of Delft, was added to these. Support to these projects will be granted within the framework of the follow-up program.

Basic Research

The developmental work in the field of wind energy should be supported by a sound knowledge of all facets that are significant for the design, construction, and use of safe and reliable wind-energy conversion systems. This basic knowledge is already available to a large extent, distributed among various branches of the Technical universities, certain TNO [Netherlands Central Organization for Applied Natural Scientific Research] institutes, the NLR [National Aeronautical and Astronautical Research Institute], and the KNMI [Royal Dutch Meteorological Institute].

It is partly the task of the BEOP to assemble this scattered but available information in such a way that manufacturers and users of windmill installations can make optimal use of it.

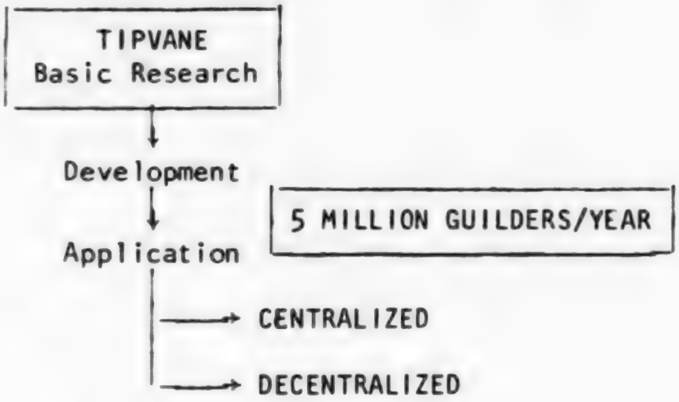
There have been urgings from various quarters to establish a so-called "Wind Institute" to which all of the basic and applied research in the field of wind energy would be subordinated. The establishment of such an entirely new, independent institute with its own buildings, personnel, and wind tunnels would, however, be a costly and time-consuming affair. An alternative is to place the "Wind Institute" under the ECN [Energy Research Center of the Netherlands], making as much use as possible of the knowledge and infrastructure existing at KNMI, NLR, the technical universities, and TNO.

BASIC RESEARCH

"WIND INSTITUTE"

ECN - NLR - THD - THE - TNO - KNMI

AMOUNT AND BEHAVIOR OF WIND
AERODYNAMICS
AERO-ELASTICITY
VIBRATIONS
DESIGNS
DESIGN CRITERIA
CALCULATIONS AND MEASUREMENTS
REGULATION AND SECURITY
SUCTION EFFECTS
CONVERSION SYSTEMS
SPATIAL AND LEGAL ASPECTS



One special project is the tipvane research. The tipvane concept is in fact the only new technical "invention" in the windmill field that could mean a significant stimulus to the application of wind energy on a large scale. But the whole development is still in the research stage, and hence this subject is included in the basic research chapter. As soon as it has been shown by the experimental installation in Hoek van Holland that a considerable increase in the energy yield per m^2 of rotor surface can be achieved outside the wind tunnel, too, a start can be made with product development.

Organization, Planning, Financing

Organization

It is proposed to have all activities within the framework of the Extended National Wind Energy Research Program carried out in the same way as in the previous program. For this purpose the program is divided into component projects, the execution of which is entrusted to the firms and institutes that are best equipped and prepared to extend their cooperation for the purpose. In general an attempt is made to involve Netherlands industry as much as possible in the developmental work.

The coordination of activities again lies with the ECN's Bureau of Energy Research Projects [BEOP]. To put the BEOP in a position to be able to act purposefully and effectively, it must be given the necessary authority and responsibility.

Planning

The extended program is set up for a period of 3 years (1 January 1981 to 1 January 1984). For the small-scale projects this period is long enough to arrive at tangible results. For the big projects listed in the centralized section this period is generally too short. In 3 years' time no prototype of a big windmill (rotor diameter at least 50 meters) can be designed, built, and adequately tested. For the proposed wind installation not even the complete design can be ready by that time. Now this is not so bad in itself, since the decision to construct it will not be made until the design is completed and a reliable idea of the total costs has been obtained.

Financing

The following sources can be drawn upon for the financing of the program:

- General financing of NOW: Ministry of Economic Affairs;
- Contributions of the institutes themselves: ECN, the technical universities, TNO, and IMAG [expansion unknown];
- Contributions of industry;
- Contributions of polder boards;
- Contributions of government agencies (e.g., Ministry of Agriculture, Ministry of Science Policy, municipal administrations, etc.);
- Contributions of financing companies (NOM [expansion unknown], NEOM [Netherlands Energy Development Corporation]);
- Public credits (development, innovations, demonstration projects); and
- Public subsidies (WIR [Investment Accounting Act], energy saving, small-scale activities).

A definite policy is necessary here, as otherwise endless discussions would arise concerning who whould should pay what.

The estimated total costs will be:

Decentralized	1981-1984: 20 million guilders
Centralized	1981-1984: 50 million guilders
Centralized	1981-1987: 200 million guilders
Research	5 million guilders a year.

8815
CSO: 3102/405

ENERGY

FAVORABLE FINDINGS FOR SOLAR INSTALLATIONS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 2 Sep 80 p 5

[Text] Replying to a question in the Bundestag, the government read a statement about currently available experience with solar installations in government buildings. Even if statistically conclusive statements cannot be made until after the solar installations in government buildings have been in operation for a minimum of three years, according to the government reply, on the basis of information available so far the following initial experiences can be reported:

The solar collectors are in good to satisfactory condition. Where this was not the case in individual exceptions, principally because of errors in on-site installation or product defects, the collectors have been exchanged under guarantee by the manufacturer.

The laying of pipes for the collector field has, as a rule, been carried out neatly. In a few cases, the thermal insulation for the pipes is in need of improvement.

There are hardly any complaints about the storage systems. However, the volume of the storage systems could not always be optimally designed, since structural considerations had to be taken into account.

The hookup of the solar system to the existing conventional heating and hot water system and the controls for its timing and regulation turned out extremely well. Considerable uncertainty seems to prevail among both the manufacturing and installation firms in the choice of the correct method of regulation, particularly in the case of larger installations with divided storage capacity.

The interim findings of the government, represented by the Ministry of Research, are that the so-called "growing pains" of solar installations, in the majority of cases, can be attributed to the breakdown of conventional plant components, relatively simple errors in installation and problems with regulation.

9581
CSO: 3102/412

EXPERIMENTAL WIND GENERATOR TO BE OPERATED IN WALES

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 2 Sep 81 p 5

[Text] The electricity generating board for England and Wales will acquire a wind-powered generator with an output of 200 kilowatts. It is to be set up on land, near the Carmarthen Bay generating station in South Wales. It will be built jointly by James Howden, Ltd. in Glasgow and the American manufacturer Wind Turbine Generators, Inc., in Buffalo, New York. The rotor will have a blade diameter of 25 meters and the hub will be at a height of 25 meters, so that the device will have a height of 37.5 meters from the ground to the blade tip. The design from Wind Turbine Generators was selected from five bids. The entire project, including recording equipment, earth moving and pouring the foundations, will cost about 5 million pounds sterling.

The operation of the wind-powered generator, whose current will be fed into the general grid through an 11-kilovolt line, will be constantly monitored to acquire data for further development work. The small "windmill" is to provide operational experience for the electricity board first, before it commissions medium-sized generators with an output of at least 1 megawatt each. The choice of some of the locations for these generators, which are being planned in groups of 10 machines, has already been narrowed down. These generators would be erected at intervals of about 800 meters. But the electricity board responsible for northern Scotland (North of Scotland Hydro Electric Board) has already ordered a 3-megawatt wind-powered generator for the Orkney Islands, which could be in operation in 1983 or 1984. This electricity board in the far north of the country already has some diesel-powered generating stations in operation on the islands, which it is trying to replace as soon as possible because of the high cost of fuel.

9581
CSO: 3102/412

NEW PROCESS FOR ARTIFICIAL PRODUCTION OF NATURAL GAS FROM COAL

Zurich CHEMISCHE RUNDSCHAU in German 1 Jul 81 p 10

[Text] The research work for extraction of artificial natural gas from coal has made further progress, as announced by Federal Research Minister Andreas von Buelow in Bonn. Now for the first time, artificial, i.e., synthetic, natural gas has been produced in a continuous process by the gasification of coal in a pilot plant at Oberhausen-Holten. Concerned here is a technically and economically advantageous single-step fluidized bed process. The process for converting coal into synthetic natural gas proceeds in two steps: First, raw gas (coal gas) is produced from hard or brown coal. Next, the purified coal gas is converted into methane, the main constituent of naturally occurring natural gas, by means of the so-called Thyssen gas methanation process.

The gas extracted corresponds in its heat content, its chemical composition and its combustion qualities to naturally occurring natural gas. Up to now, gas produced from coal could because of its nature only be used in industry and in chemistry. Now it has become possible in principle also to use gas from coal for public energy supply and thus also in private households.

The progress in coal gasification technology is based on the Texaco gasification process developed by Ruhrkohle AG and Ruhrchemie AG. The synthesis gas produced thereby is afterward converted to synthetic natural gas in the methanation step developed by Thyssengas GmbH and Didier Engineering GmbH. Since 1977, development of the processes has been supported with funds from the "energy research and energy technologies" programs by the Federal Ministry of Research and Technology.

5586
CSO: 3102/398

INDUSTRIAL TECHNOLOGY

INDUSTRIAL ROBOTS NOW BEING MANUFACTURED IN SPAIN

Duesseldorf VDI NACHRICHTEN in German 21 Aug 81 p 27

[Text] Not long ago the Spanish press reported with pride that the first industrial robot manufactured entirely in Spain had been delivered to Ford Espana. The Spanish group Friends of VDI investigated the report and found it only partly correct. True, the (Spanish) firm ASEA had delivered an industrial robot to Ford at Almusafes/Valencia; however, Garcia-Moton, technical director of the supplier firm in Madrid, made known upon questioning that up to 50 percent of the robot's parts were imported.

It is interesting, however, that the Spanish subsidiary of the Swedish robot giant has undertaken the series production of two types of industrial robots. These are the models designated in Sweden as IRB 6 and IRB 60 with payloads of 6 and 60 kg, respectively. The installation sold to Ford was of the latter type, weighing 750 kg. A contract for 20 to 25 units per year is anticipated; meanwhile, efforts are being made to increase the proportion of Spanish parts to about 90 percent.

The technology and several electronics components will still have to be imported. In the future Spanish technicians and engineers will take over the job-analysis task and develop the software in cooperation with the customer. After that, a positive export development is expected.

The industrial robots now being manufactured are considered primarily for production, deburring and finishing operations. Additional areas of application are presently being developed such as the application of bonding materials, loading and unloading machines, feeding injection molding processes and, above all, for welding work.

ASEA has turned to the Spanish automobile manufacturers and hopes to rein Figueruelas near Zaragoza. Spanish engineers are already being trained for this at Opel in Germany. The German branch of ASEA has finally delivered a series of robots to Opel as well as additional units to Ford, BMW and Daimler-Benz.

The Swedish parent company established the Spanish factory in 1912; in 1965, this company passed totally into the hands of the Swedes.

9160
CSO: 3102/426

FINANCIAL STRAITS HELP DETERMINE NEW R&D ORIENTATIONS

Duesseldorf VDI-NACHRICHTEN in German 10 Jul 81 p 21

[Article: "New Approaches in Research Policy. Von Buelow: 'Difficult and Lengthy Reorientation'"]

> [Text] Financial difficulties are expected to continue for some time to govern the research and technology policy discussion as well as the argument about such catchwords as direct/indirect support. However, gradually new approaches are also becoming apparent for a new concept of the federal government's research policy; they concern the content as well as the method of support and are to a great extent conclusions drawn from the financial bottlenecks.

The Federal Minister for Research and Technology (BMFT), Dr Andreas von Buelow, made this clear in a conversation with the Science-Economics-Policy (WWP) Information Service, in the following six points:

-- Research in the areas of environment, climate, microelectronics, biotechnology and information technology is to have priority.

-- In the future the most intelligent solution must be sought, rather than the most perfect or the most costly solution.

-- In basic research a "minimum measure of accountability to the taxpayer is absolutely necessary," resulting, therefore, in more government financial control.

-- In the heretofore neglected humanities and social sciences the laender and scientific organizations are to be responsible for capacity of "high qualitative value."

-- The large research establishments should, following the example of the Fraunhofer Society (FhG), try harder to obtain research orders. They can thus balance out personnel cuts.

-- Contact between basic research and industry must be improved; von Buelow expects concrete proposals, such as proposals from the chemical industry on the division of work between government and the economy in this area.

The federal research minister sees the requirement for economical use of money as a real chance for new emphases in research and technology policy. To be sure, this process of reorientation is very difficult and lengthy. He sees the coming discussions on the federal 1982 budget as still entirely under the heading of coping with the crisis: What is "valuable in the long term" shall as much as possible not be damaged; in places where, according to his concepts, industry must participate more actively, where the financial capacity of the federal government simply is not sufficient, and where the long-term use is not so great, the federal government wants to pull out. Still-relevant actual cases are: The German-American-Japanese project for coal liquefaction, the cabin taxi, the ZEPHYR pilot plant at the Institute for Plasma Physics, a few demonstration projects, and the planned Rheine-Freren test track for wheel-rail tests.

By means of this last example, the BMFT explains how he conceives obtaining the most "intelligent" solution with available means instead of the "best" solution: instead of building a completely new track for test purposes only, at a cost of DM 300 million, the Federal Railways could carry out the tests on their newly constructed tracks. Where public installations are concerned, the most perfect solution has always been attempted in the FRG because there was a lot of money: here rethinking is needed. For government support, von Buelow formulates: "Those who adjust most rapidly should also be helped most rapidly."

Flexibility in the Research Budget

On the subject of supporting science through increased budgetary flexibility, above all in basic research, von Buelow is very cautious. He sees the government administration's efforts to attain increased financial control and absolute transparency of the science budget as the result of certain abuses, but above all within the framework of economy considerations. The finance minister's "fair request" to want to know what he is authorizing money and jobs for should be heeded. They cannot "simply disappear in the pool without someone knowing where they later reappear." To be sure, the research minister doubts whether it is necessary to go so far as to list the projected jobs completely in the federal budget plan; it will still be necessary to wrestle over this with the finance minister and the budget committee.

The federal government vigorously supports the principle of self-administration of science. The autonomy of the German research community and the Max Planck Society must be maintained; the federal government must limit itself to creating guidelines for basic research, which itself determines its tasks and methods. To be sure, it cannot be rejected out of hand that the federal minister for research and technology--by means of financial guidelines, especially in the case of large-scale investments--can have a decisive influence on determining the main effort, e.g., in the large-scale research establishments.

"Bridging Function" of the BMFT

Von Buelow sees for his department a bridging function between parliament, government and science. Basic research has the possibility of voicing its interests through the BMFT in the political area. The other way around, the tying in of science to the total political responsibility on the basis of an immediate relation between science and the BMFT is basically guaranteed thereby. "The uncoupling of science from general politics can lead to an isolation of science and can stir up increasing skepticism by the public toward science."

Von Buelow asked scientists to show more courage in the argument with the government administration. "Many professors have no idea how budget plans are arrived at and are then surprised when they think that they have been completely raked over the coals by government officials." Scientists must become more familiar with budgetary questions and must also in their own commitees not simply accept everything but instead resist those who interpret laws bureaucratically.

Von Buelow assigns special weight to strengthening the humanities and social sciences. He says that we should not allow ourselves to be discouraged by the closing down of the Max Planck Institute for the Social Sciences, and that reverses occur, in part because the desired quality was not attained. The Max Planck Society should make a new approach in sociology. Incidentally, the federal research minister sees the laender and the German research community above all as responsible for supporting the humanities and the social sciences. The Science Center in Berlin, which is under the responsibility of the federal government, is not to be extended beyond present plans for now, but is instead to be consolidated first.

In the area of large research establishments, care must be taken that these not carry out a catchall of the smallest projects, but also do basic research. The multidisciplinary research potential available there should--especially when the center undertakes new tasks--also be put at the disposal of regional technological development. Small and medium-sized enterprises should be able to take advantage of the know-how available there. The Fraunhofer Society has developed very well with this orientation. Large research establishments should also go in this direction. Von Buelow referred to the 1.5 percent annual cuts in the personnel of large research establishments which he is demanding over the next 5 years as a "very moderate" pace, which, however, could also be shortened to 3 years. He is now awaiting proposals from the centers.

Fraunhofer Society Is an Example

They will, however, also be given the possibility of soliciting additional orders from the economy, following the Fraunhofer Society's example, in order to hold onto their personnel. A few centers have always done contract research.

The federal research minister was very critical of the chemical industry's conduct. The fact that Hoechst AG has invested millions for basic research in an American and not in a German research establishment disappoints him very much, as does the restraint shown thus far by the industry toward considering the founding of a Max Planck institute for polymer research.

Von Buelow expects neither general criticism nor surprising actions but instead concrete proposals by the chemical industry on a possible division of work in research.

Entwicklung des Haushaltsplans des Bundes 1)

Einzelplan 30 (BMFT), ausgewählte Programmbereiche in Millionen DM (Stand 27. 2. 1981) 2)

	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
3)	IST	IST	IST	IST	IST	IST	Entwurf 4)	BMFT-Anforderungen 5)			
BMFT-Haushalt 6)	4114	4021	4208	4702	5563	5722	6140	6870	7213	7524	7762
Steigerung gegenüber Vorjahr (v. H.) 7)		– 2,3	+ 4,7	+ 11,7	+ 18,3	+ 2,9	+ 7,3	+ 11,9	+ 5,0	+ 4,3	+ 3,2
Physikalisch-chemische Grundlagenforschung *) 8)	392	405	408	463	482	515	528	584	636	694	774
Anteil am Einzelplan (v. H.) 9)	9,5	10,1	9,7	9,9	8,7	9,0	8,6	8,5	8,8	9,2	10,0
Steigerung gegenüber Vorjahr (v. H.) 7)		+ 3,3	+ 0,7	+ 13,5	+ 4,1	+ 6,8	+ 2,5	+ 10,6	+ 8,9	+ 9,1	+ 11,5
MPG (Betrieb und Investitionen) einschl. Sonderfinanzierung 10)	270	269	284	307	319	335	359	374	386	406	432
Anteil an Einzelplan (v. H.) 9)	6,6	6,7	6,7	6,5	5,7	5,9	5,8	5,4	5,4	5,4	5,6
Steigerung gegenüber Vorjahr (v. H.) 7)		– 1,1	+ 5,6	+ 8,1	+ 3,9	+ 5,0	+ 7,2	+ 4,2	+ 3,2	+ 5,2	+ 6,4

*) darin enthalten: Zentren: DESY, GSI, HMI, Beiträge an CERN, ILL, ISAS, 685 01, 893 01, und Zusammenarbeit mit ausländischen Forschungsinstituten. 11)

Quelle: BMFT (DAFIN) 12)

Key:

1. Development of the Budgetary Plan of the Federal Government
2. Individual Plan 30 (BMFT), Selected Program Areas in millions of DM (as of 27 February 1981)
3. IST [actual figures]
4. Projected
5. BMFT Requests
6. BMFT budget
7. Increase in comparison with previous year(%)
8. Physical-chemical basic research*
9. Participation in the individual plan (%)
10. MPG [Max Planck Society] (operation and investments) including special financing
11. *Contained therein: Centers: DESY, GSI, HMI, contributions to CERN, ILL, ISAS, 685 01, 893 01, and collaboration with foreign research institutes.
12. Source: BMFT (DAFIN)

5586
CSO: 3102/398

SCIENCE POLICY

POWERS OF RESEARCH MINISTRY MADE OFFICIAL

Paris AFP SCIENCES in French 30 Jul 81 pp 1-2

[Article: "Powers of the Research and Technology Ministry"]

[Text] Paris--The order assigning powers to the Minister of Research & Technology appeared in the 30 July issue of the official gazette.

The writing of this order posed some problems in the division of powers among several ministries, especially the Ministry of Industry, insofar as some agencies--such as the Atomic Energy Commission or the National Center for Space Studies, to name just two examples, which previously were entirely subordinate to the Ministry of Industry--not only do basic research, but even own subsidiaries for industrial production.

The order gives broad powers to the Research Ministry, while making every effort to include the flexibility necessary for well-coordinated public research.

The five articles of the order are as follows:

1. The Ministry of Research & Technology has the power to propose and, in conjunction with the other ministers involved, to implement national policy in the domain of research and technology.

He has authority over the General Delegation for Scientific and Technical Research [DGRST] and the Interministerial Mission for the Development of Scientific and Technical Information [MIDIST].

In matters of industrial and technological research he exercises the powers previously conferred upon the Minister of Industry by order No 78-593 of 16 May 1978. The Delegation for Innovation and Technology and ANVAR are placed, in so far as necessary, under the control of the Minister of Industry.

2. He prepares government decisions concerning allocation of resources and funds allocated by the government to civil research and development activities, namely grants to public institutions and other public technological research and development agencies. Funds earmarked for these institutions and agencies (except universities) are included in the budget of the Ministry of Research and Technology.

Concerning public institutions and other public research agencies, the Research Minister, in conjunction with the other ministers involved, is charged with the preparation and implementation of all reforms concerning their organization, personnel regulations, and all actions affecting scientific employment policy. He countersigns the supporting documents in these areas.

He must be consulted about the research programs of national corporations.

3. As regards the CNRS [National Center for Scientific Research], the Minister of Research and Technology exercises the powers previously reserved to the minister in charge of universities.

4. The Minister of Research and Technology is a party to /cooperative international scientific/ [passage enclosed in slantlines underlined in source] actions. In conjunction with the Minister of External Relations, he follows and coordinates the actions taken in this domain by the research agencies.

5. According to their involvement, the Prime Minister, the Minister of State, Minister of Research and Technology, Minister of External Relations, Minister of National Education and Minister of Industry are each charged with executing this present order.

On 23 July, Jean-Pierre Chevenement held a lengthy meeting with the directors of most of the research agencies, including those of the ONERA [National Office for Aerospace Studies and Research] and the CNET [National Center for Telecommunications Studies]. The ONERA and CNET budgets are not included in the budgetary package of the Ministry of Research and Technology.

The agencies represented at the meeting were as follows:

CNRS [National Center for Scientific Research]
ANVAR [National Agency for the Valorisation of Research]
DIT [Delegation for Innovation and Technology]
MIDIST [Interministerial Mission on Scientific and Technical Information
ORSTOM [Bureau of Overseas Scientific and Technical Research]
INRA [French Institute for Agronomical Research]
INSERM [National Institute for Health and Medical Research]
GERDAT [expansion unknown]
CEA [AEC]
COMES [Solar Energy Commission]
CNEXO [National Center for Exploitation of the Oceans]
INRIA [National Institute of Data Processing and Automation Research--Rocquencourt]
Pasteur Institute
ADI [Data Processing Agency]
IRCHA [French Institute of Applied Chemistry Research]
BRGM [Bureau of Geological and Mining Exploration]

During this meeting, there was a lengthy discussion of the national research symposium to be held next January with a view to preparation of the five-year plan for research. The minister asked the agencies to participate extensively in this symposium. Recalling the personnel relations problems in the agencies, Chevenment hoped that action would be taken in the areas of large-scale cooperation, democratization and good circulation of information.

The question of scientific and technical information, and the problem of data bases and data banks are of particular concern to the minister, who intends to initiate actions in these areas. He considers it necessary to develop the communication between the scientific community and the public. Chevenment asked the directors of the agencies to be more open with the press. The minister concluded with his concern for the preservation of the French language on the plane of international scientific relations.

Finally, regarding preparation of the 1982 budget, it was indicated that Chevenment stressed that "it is along the line of 2.5%," meaning that it constitutes the first stage in the national research effort to attain this percentage with respect to the gross national product in about 1985.

9171
CSO: 3102/410

SCIENCE POLICY

RECENT AID TO INNOVATION SHOWS LARGE INCREASE

Paris AFP SCIENCES in French 30 Jul 81 pp 11-12

[Article: "An evaluation of ANVAR activities presented to Chevenement"; passages enclosed in slantlines underlined in source]

[Text] Paris--On 22 July, Jean-Pierre Chevenement, Minister of Research and Technology visited the main office of the National Agency for the Valorisation of Research [ANVAR].

Accompanied by members of his cabinet, Chevenement was welcomed by Claude Pierre, president of the administrative council, and by Christian Marbach, general director of ANVAR. During a meeting, Chevenement had the opportunity to have shown to him the organization and activities of ANVAR, particularly those of the first half of 1981.

On this point, it was stressed that the rate of ANVAR activity, profoundly transformed in 1980 (the first full year after the reform of July 1979) remained at a high level the first half of 1981.

Aid to innovation, the object of which is to promote innovation and technological progress at all stages of the innovation process, represents the most significant budget item. In 1980, ANVAR received about 1,490 requests for aid to innovation and accepted 1,047 requests, for a sum total of 547 million francs.

During the first half of 1981, 973 requests for aid to innovation were presented to the commission; 691 were accepted, for a sum total of 322 million francs. These figures clearly reveal the increase in volume from one year to the next, both in number of requests and total aid, which shows the undeniable success of this procedure. At the end of July 1981, the total should exceed 400 million francs. Taking into account this total and the requests being processed, it can be predicted right now that the sum total of aid to innovation granted in 1981 should equal about 550 million francs, which will be made possible thanks to the additional 60 million francs in the total budget, which will complete the existing grants.

The main office made 97 grants for a total of 175 million francs, and the regional offices made 594 grants for a total of 147 million francs. The grants which represent an average 33 percent of the innovation programs planned by the beneficiaries (45 percent in district offices) are generally advances, repayable in case of success.

This distribution of decision-making among the main office and district offices is to evolve towards greater regionalization, since from 1 July the regional representatives of ANVAR can grant aid up to 1 million francs, where they were previously limited to 500,000 francs.

The regions most benefiting from the aid to innovation granted by the regional representatives are Rhone-Alps, which will receive the second meeting of ANVAR in Lyon next 15 and 16 October, then Ile-de-France, the Loire region and Nord-Pas-de-Calais.

The allocation of subsidies for innovation, the object of which is to encourage to PME [Small and Medium-Sized Businesses] to subcontract their research work to approved agencies or experts, progressed at an even more significant rate, partly due to the recent extension of its field of application, but also especially because this procedure is becoming better known by the businesses. Thus, while in 1980 ANVAR granted 1,756 subsidies for a sum of 12.8 million francs, 1,134 subsidies were paid or were in the process of being paid, by 30 June 1981, for a sum of 11.7 million francs.

In almost all the cases, the subsidies were granted by regional representatives of ANVAR, and the allocation procedure takes several days (the procedural delay being 2 to 4 months for aid to innovation). About 50 percent of the total innovation subsidies goes to the Ile-de-France region.

The district representatives of ANVAR, who are handling an increasingly more significant proportion of aid and subsidies for businesses, are likewise in the process of developing their services designed for the research agencies and regional laboratories.

The whole of these activities necessitates significant reinforcement of their personnel and equipment, which will be accomplished in 1981 and 1982, thanks to corresponding budget allocations.

Aid to Innovation (1 Jan to 30 Jun 81)

Item	Main Office	District Offices*	Total
Number of requests registered with ANVAR	197	783	980
Number of requests submitted to the commission	185	788	973
Number of requests deferred	20	82	102
Number of requests settled	165	706	871
Number of files closed	13	-	13
Number of requests refused	51	112	163
Number of requests accepted	97	594	691
Total sum accepted	175,330,000	147,089,894	322,419,894

*Interim figures

9171

CSO: 3102/410

FOUR PROTOTYPES OF 'AUTO 2000' INTRODUCED

Frankfurt/Main FRANKFURTER ALLGEMEINE in German 15 Sep 81 pp 9-10

[Article by Gerold Lingnau: "How The Automobile Could Look in The Year 2000"]

[Text] What will the automobile look like in the year 2000? That cannot be known exactly. But attempts can be made to anticipate it according to the state of technology today, even to construct it in advance. This is a fascinating problem for engineers. So there was some interest shown in the automobile industry, when the Minister of Research--at that time still Volker Hauff--gave the impetus in 1978 for the research project "Auto 2000" and promised to make subsidies available. Four competitors were finally left: Daimler-Benz, Audi NSU, Volkswagen and a work group from university institutes in Aachen, Berlin, Darmstadt and Stuttgart, headed by Professor Breuer in Darmstadt. All of them had to realize their ideas for the car of the future on a very short schedule. Now, just a few days before the opening of the Frankfurt Auto Show, the four prototypes were introduced.

The "Demonstration of the Results of Automotive Technology Research in Integrated Total Concepts of Experimental Passenger Models," as the "Auto 2000" project is called officially, was to cover three principal areas: Energy conservation, environmental protection (less noise and exhaust gases) and safety. Accordingly, the parameters in the specifications were formulated and set out so that no one of the three lines of development should have precedence over the others--and at the expense of the others. The finished designs should be suitable for everyday use, so that they can be adapted for series production without great difficulty--which does not mean that the prototypes would have to be forerunners of production cars in the form presented.

The automobile presented by Audi NSU is the closest to a present-day middle-class car, even in its external shape. The five-seater of impressive size is far more streamlined than today's Audi, its coefficient of drag of 0.30 is 25 percent lower than is normal today. It was achieved by a great deal of detail work, for example, windows fitted flush to the body. The car's roof and smooth floor are of lightweight sandwich construction bonded to the steel load-bearing body structure. Airbags and a child's seat integral **with** the back seat contribute to occupant protection. A gasoline engine with a turbocharger, tuned for greatest economy, drives the front wheels; it is so effectively soundproofed that road noise is determined only by tire noise.

Daimler-Benz also decided to build a large, comfortable prototype which is equipped with all luxury-car extras. They wanted to show that a long-distance car of this type, for which there will be a demand even in the future, can make do with low fuel consumption. Of the three power plant variations envisioned--a gas turbine with highly developed ceramic components, an 8-cylinder gasoline engine with reduced power and cylinder cutout in part -load operation and a 6-cylinder diesel with two exhaust-driven turbochargers in series--only the diesel has so far become a reality in the prototype; it too is in a noise-tight compartment. The automatic transmission can be programmed: The driver has the choice between "Economy," "City" (specially quiet) and "Fast." Like the Audi, the Mercedes of the future also has a "soft" nose section of plastic for better pedestrian protection in accidents. An information system transmits all important data to the driver. An antilocking system for the brakes, distance warning system and a device that prevents wheelspin during acceleration complete the prototype, which, with its extended tail, has a drag coefficient of less than 0.3.

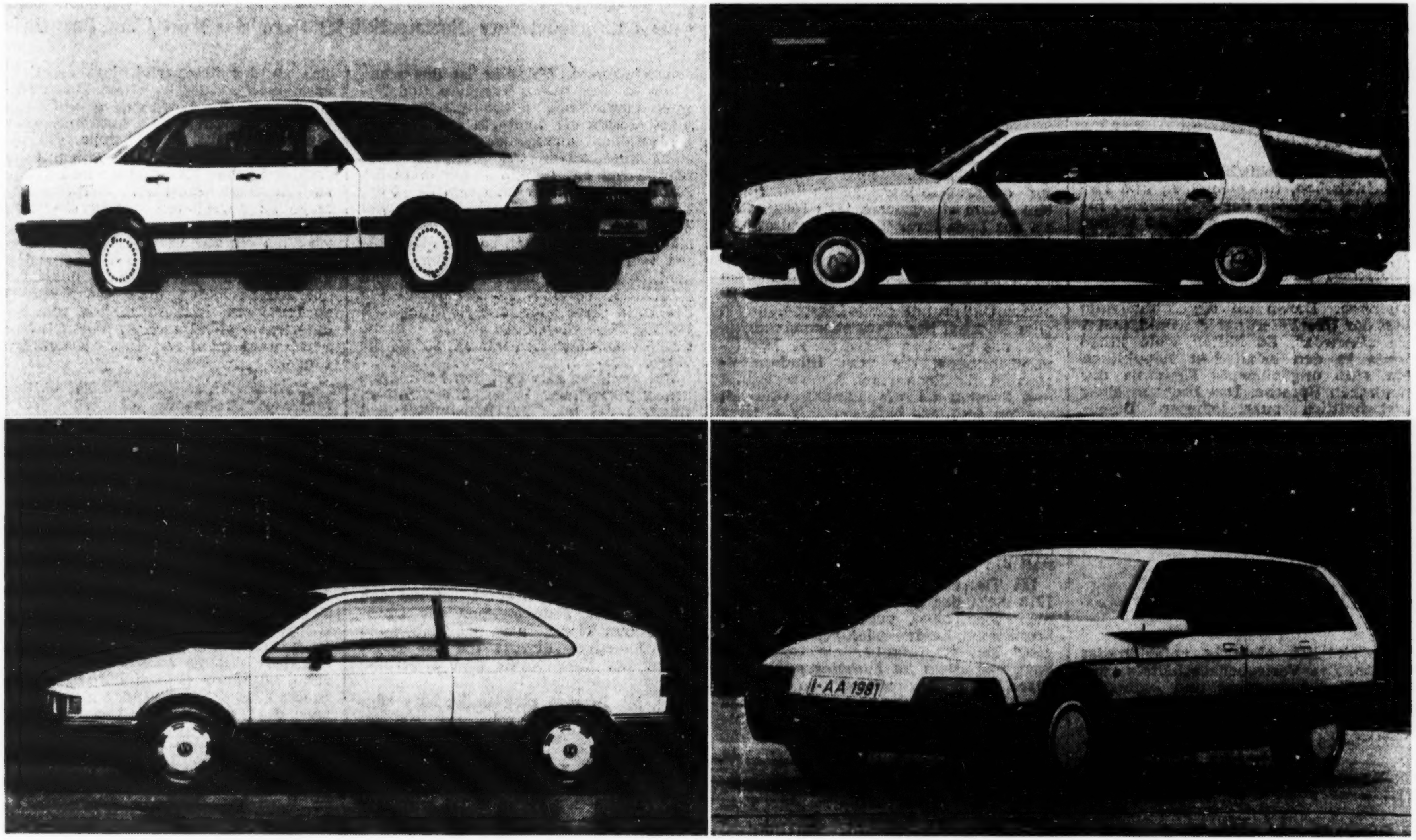
The university work group placed importance on accident protection for pedestrians and bicyclists in their development. All the areas on their prototype that could be involved in the event of an accident are padded and smoothly shaped. Additional measures were directed at safety in side collisions. The car is a four-door station wagon with front-wheel drive, its drag coefficient is less than 0.25. The power plant is a diesel engine with direct fuel injection and a turbocharger, which was developed by MAN [Maschinenfabrik-Augsburg-Nuernberg] on a Citroen engine block. It is coupled to an infinitely variable mechanical automatic transmission with electronic control. The car also uses a driver information system. Fuel consumption is said to be only 6.6 liters/100 km, with totally competitive middle-class performance.

Volkswagen contributed the only smaller car to the four. Its interior space is larger than in the VW Rabbit but smaller than in the Dasher. With a drag coefficient of 0.25, this sedan is also extremely aerodynamic (Rabbit: 0.42). The bodywork uses a great deal of aluminum and plastics. The driver is extensively supported by electronics: Not only for information (digital displays on the instrument panel), but also in controlling heating and ventilation (by microprocessor) and in the activation of the "automatic device for utilization of inertial energy" (the engine is automatically switched off when the car stops and then started again by the flywheel which continues to spin). A 3-cylinder diesel engine with direct injection and a turbocharger--consumption about 4 liters/100 km--or a turbocharged gasoline engine are under consideration as possible motors, both of them in noise-tight compartments.

When could the prototypes become real automobiles? Even if they were intended to be (which they are not), at least 8 to 10 years would be required--even in the case of the one closest to production status--the Audi. Many manufacturing problems would have to be solved, large parts of the planned electronics systems are still untested and enclosing the engine still has hidden problems (danger of overheating). But individual components of these cars of the future could be used earlier in series production. One must look at the prototypes from this perspective, as they are now being introduced in Frankfurt.

However, what was supposed to be celebrated here as an important way station along an interesting path, turned into political discord. Surprising everyone, Minister of Research Andreas von Buelow told the chief engineers of the three automobile companies present that he could not provide money for the impending test phase of the prototypes: Only the university group would continue to receive subsidies. The budget cuts that were being asked of him could not be managed in any other way. Why Buelow kept back this surprise--which sets at nought all promises and contracts--for the official introduction could not be fathomed. In any event, the three board members, Professor Fiala (VW), Professor Breitschwerdt (Daimler-Benz) and Piech (Audi NSU) heard of it for the first time on this occasion. They expressed their disappointment plainly. It was not so much a matter of the money: The prototypes would not remain "research ruins," because the companies would test them on their own--although perhaps not as extensively as planned earlier. It was painful to discover how projects designed for the long term were being abruptly terminated by one side. The relationship of trust between the giver and the receivers of subsidies was being jeopardized for the future.

Those critics who had doubted from the outset the need for government financial assistance for a project like this should be satisfied with the end of the affair. In their opinion, the automobile industry would have started the same developments without assistance from Bonn--in fact, they would have been forced to. That is not true either: The prototypes show that the designers could get a little farther away from immediately realizing their ideas during the design stage, thanks to the subsidies. That means: They could "fantasize" a little more than usual. And that could only help the bounty of ideas for the "Auto 2000."



Four versions of the "Auto 2000": Audi (top left), Mercedes (top right), VW (bottom left) and the design of a university work group.

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20 Oct. 1981